SERVICE HANDBOOK

SandBlaster®

Self-Cleaning Induced Draft Multi Flue Commercial Gas Water Heaters

MODELS COVERED

SBN71 120 Through SBN85 390 (A)
Series 108 Models and
SBD30 150, SBD30 199
Booster Heaters

SBN Meets Low NOx Requirements of SCAQMD Rules 1121 & 1146.2

Part Number 317927-000
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state COMMERCIAL

Table of Contents

SBN 71-120 thru 85-390, SBD30-150/199 SERVICE HANDBOOK INTRODUCTION

This service handbook is a supplement to the SBN and SBD151/201 Installation and Operation Manual. The handbook provides information on servicing and troubleshooting State SBN/SBD30-150/199/ water heaters in the field. While this handbook is not intended to be all inclusive, it contains:

- step-by-step procedures with illustrations to verify proper installation, operation, and troubleshooting
- quick reference data to assist in servicing the product line
- answers to common questions encountered in the operation of the product line.

The handbook is intended to be used by licensed plumbing professionals. Reference should be made to the installation manual accompanying the product. If you are experiencing a problem not covered in this handbook, please contact the State Technical Information Department at 1-800-365-0024 or your local State Water Heater representative for further assistance. No duplication or reproduction of this book may be made without the expressed written authorization of the State Water Heaters.

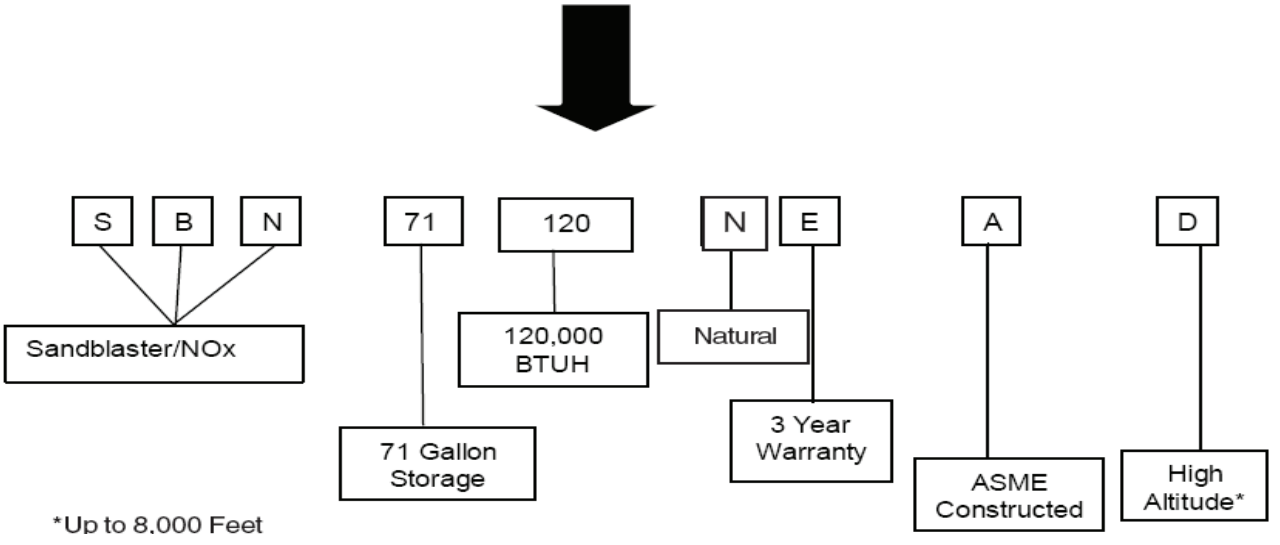
QUALIFICATIONS

Installation or service of this water heater requires ability equivalent to that of a licensed tradesman in the field involved. Plumbing, air supply, venting, gas supply and electrical testing skills are required.

TOOLS REQUIRED

- Phillips head screwdriver
- standard screwdrivers
- 3/8 and 7/16 inch open end wrench
- set of marked drill bits
- electrical multimeter tester capable of measuring continuity, AC voltage and DC voltage
- gas pressure gauge or manometer
- water pressure gauge
- thermometer (range 0 - 220 degrees F)
- 1/2 inch socket with extension for removal of the clean out cover
- 1-1/16 inch socket with extension for anode removal

COMMERCIAL TANK TYPE GAS MODEL NUMBER BREAK DOWN



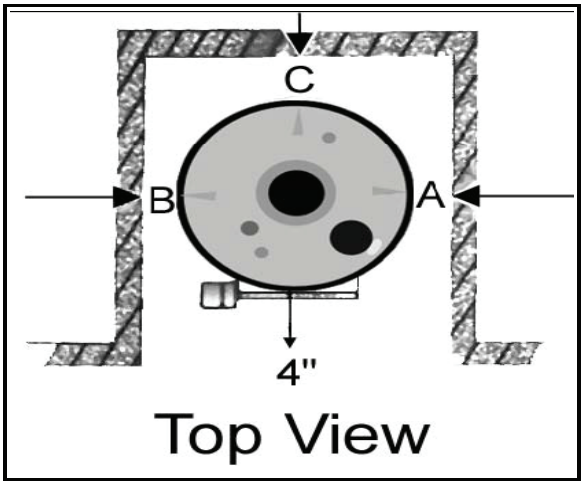
Rev. 1 Adds SBD30-150 and 30-199 models with parts lists. Adds SBN series 108 parts list.

INSTALLATION CONSIDERATIONS - CLEARANCES

This portion of the handbook reviews some often overlooked installation considerations clearances, air supply, gas pressure requirements, and venting—taking note of necessary installation requirements for SBN and SBD30-150/199 . The installation manual covers most of these items in detail.

A 24-inch clearance for all serviceable parts is recommended. Clearances may vary between models. See instruction manual or the label on the heater for clearances applicable to your specific model.

TOP AND FRONT VIEWS OF MINIMUM CLEARANCES TO COMBUSTIBLES



MINIMUM CLEARANCE TO COMBUSTIBLES

Model Number	"A" Right Side	"B" Left Side	"C" Back "D"	Ceiling
SBN-120 thru 200A	2"	2"	2"	12"
SBN-250/A thru 310/A	3"	3"	3"	12"
SBN-366	6"	6"	6"	6"
SBN-390	4"	4"	4"	4"
SBD30-150/199	2”	2”	2”	12”

A, B, and C clearances to non-combustibles is “0” inches - a 12 inch clearance to cover remains unchanged.

REQUIRED EXTERIOR CLEARANCES

The illustration below shows the required clearances for venting units using natural draft venting.
The vent must extend at least 3 feet above the highest point where it passes through a roof of a building and at least 2 feet higher than any portion of a building within a horizontal distance of 10 feet (for vents of 12 inches in diameter or less).
References: NFPA 54 2006; ANSI Z 223.1 SEC 12.6.2 and Sec12.7.2 may allow reduction to 8 feet with a "listed vent cap."
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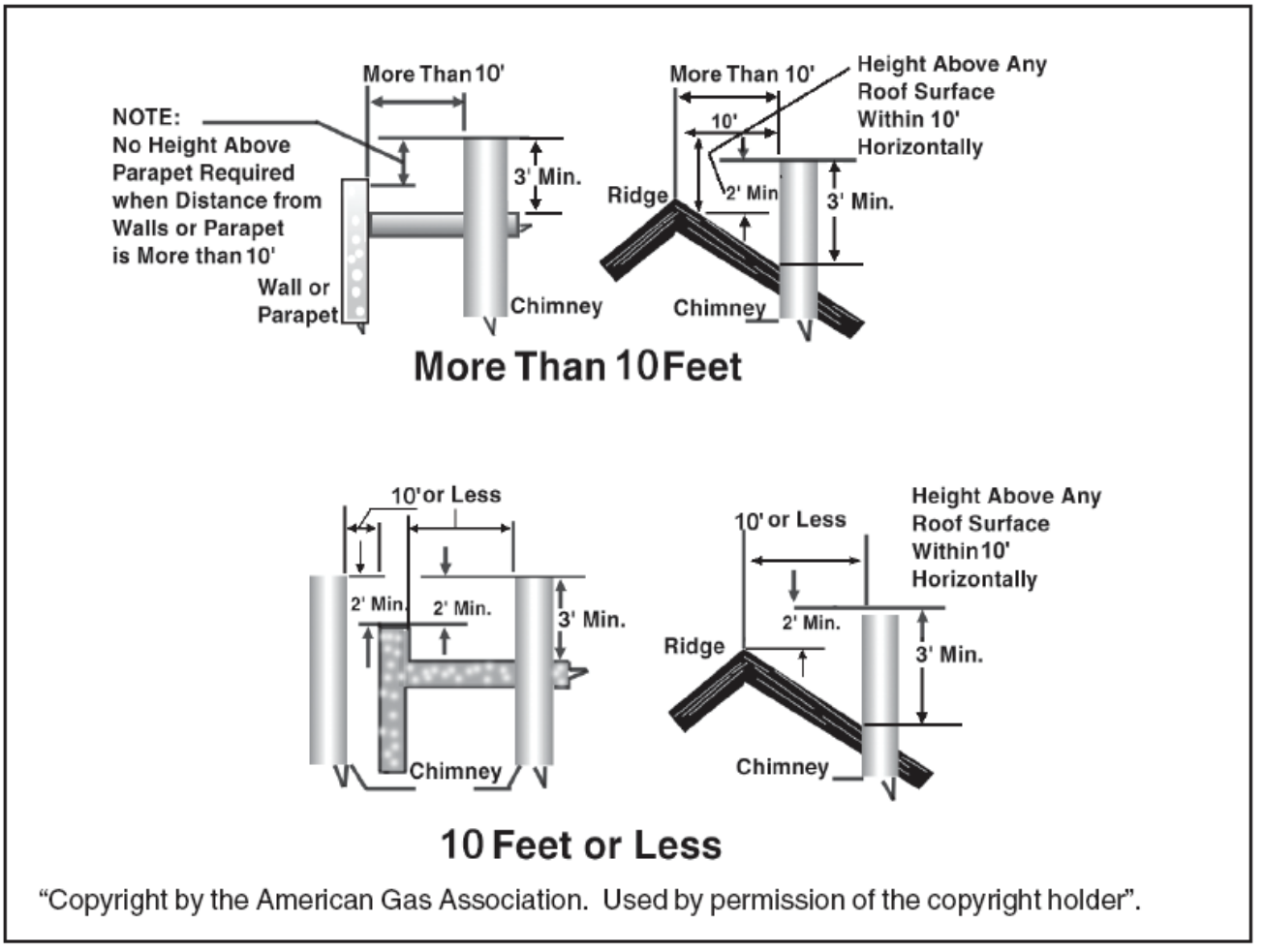

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REQUIRED EXTERIOR CLEARANCES

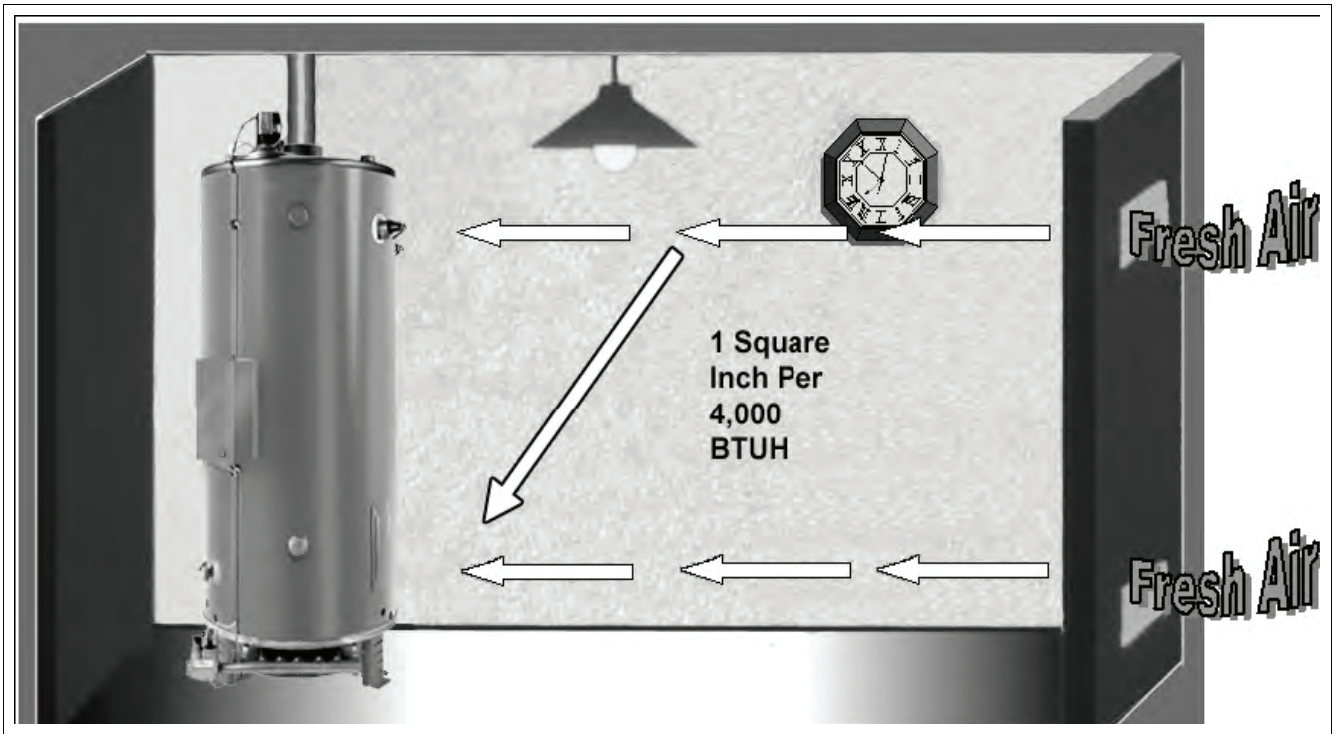
Stoichiometric or theoretical complete combustion requires 10 cubic feet of air per 1,000 BTUH of gas supplied. The National Fuel Gas code also recommends an additional 2.5 cubic feet of "excess" air. For information on minimum make-up air opening sizes for various building installations, refer to the National Fuel Gas Code NFPA 54, ANSI Z223.1, Sec. 5.3

INSUFFICIENT MAKEUP AIR ..... NEGATIVE AIR PRESSURE .....DOWNDRAFTS

One common example is in a restaurant installation where exhaust vent equipment was not considered in sizing make-up requirements. This condition may result in air being back drafted by the restaurant exhaust equipment through the heater causing the draft proving switch to open and/or erratic heater shutdown.

MAKE-UP AIR – DIRECT COMMUNICATION WITH OUTDOORS

A fresh supply of make-up air for combustion can be supplied to the heater through make-up air ducts, which directly communicate with the outdoors.(Not Direct Vent)



Two openings are required: one within 12 inches of the top of the enclosure and one within 12 inches of the bottom of the enclosure. Each opening must have a free area of not less than 1 square inch per 4,000 BTUH of the total input of all appliances within the enclosure. The lower opening primarily provides combustion air. The upper opening provides vent dilution air and acts as a relief opening for flue gases should the vent become obstructed or a downdraft condition occur.

Additionally, when the heater is installed in a confined space and communicating with the outdoor air, one permanent opening, beginning within 12 inches (30 cm) of the top of the enclosure, must be permitted where the equipment has clearances of at least 1 inch (2.5 cm) from the sides and back, and 6 inches (16 cm) from the front of the appliance. The opening must directly communicate with the outdoors and must communicate through a vertical or horizontal duct to the outdoors or spaces (crawl or attic) that freely communicate with the outdoors, and must have a minimum free area of a) 1 square inch per 3,000 BTUH (7cm2 per kW) of the total input of all equipment located in the enclosure and b) not less than the sum of the areas of all vent connectors in the confined space.

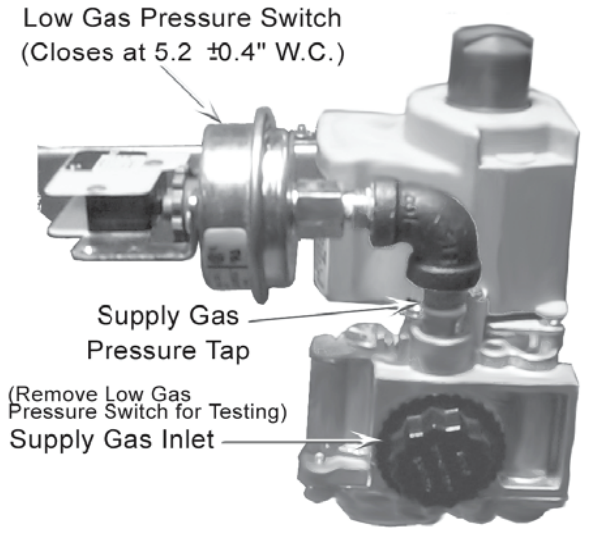
CONTAMINATED AIR

Along with adequate make-up air, the quality of the air is important. Contaminants in combustion air can lead to premature heater failure. Vapors from bleaches, soaps, waxes, salts, etc. are drawn into the combustion chamber with the make-up air and, once fired, mix with water vapor in the gases to form extremely corrosive hydrochloric or hydrofluoric acid and other corrosive by-products.

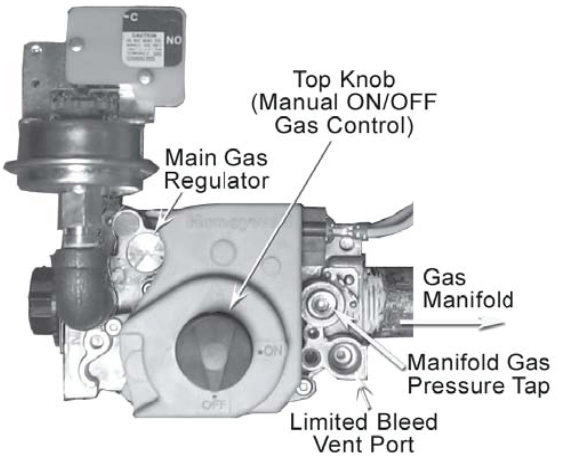
AIR FOR COMBUSTION – FLAMMABLE ITEMS

GAS VALVE

The supply gas pressure is normally measured at the gas valve inlet gas pressure tap, if available, when the gas is flowing. The manifold gas pressure is measured at the manifold pressure tap of the gas valve when the gas is flowing. Gas valves used are 24 volt AC combination-step opening gas valves. They incorporate the main valve and gas pressure regulator into one body. The Low Gas Pressure Switch, the Supply Gas Inlet, and the Supply Gas Pressure Tap are shown in the Inlet View to the right.



INLET VIEW

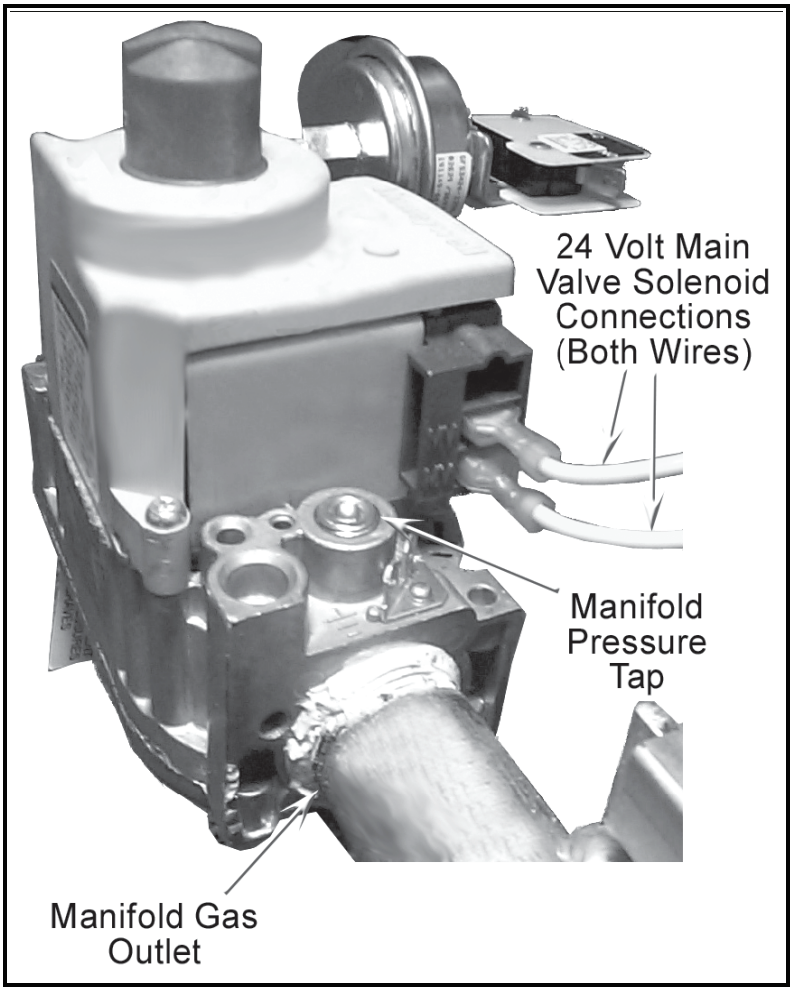


TOP VIEW

The top view of the gas valve, shown on the right, shows the Main Gas Regulator, Manifold Pressure Tap, Top Knob, and the Limited Bleed Vent Port. The main gas regulator is found under the silver cap (silver cap for Natural Gas or black cap for Propane) screw. It is factory preset to 3.5 inches W.C. and
adjusts gas pressure output from 3.0 to 5 inches water column. Caution: Always test the manifold pressure at the outlet when the gas is flowing.

GAS VALVE

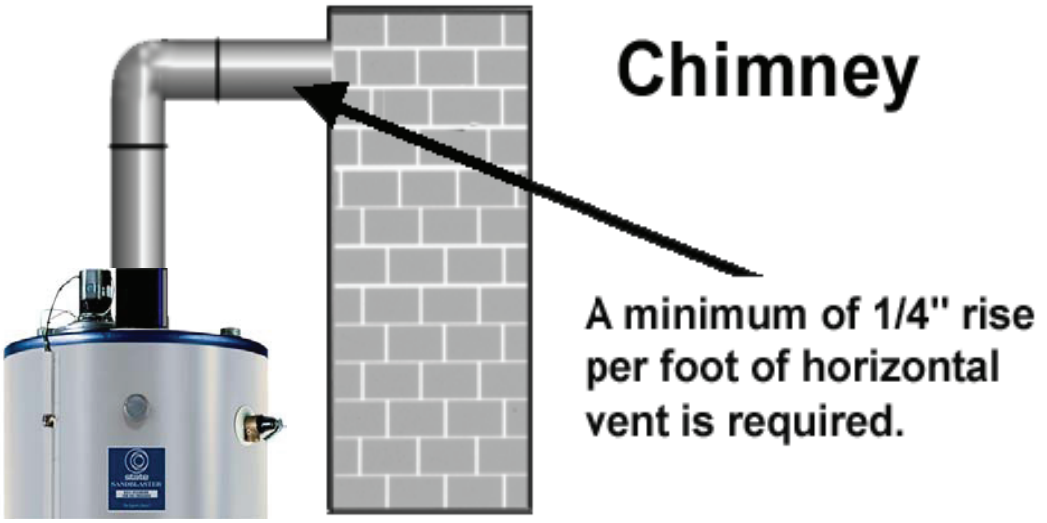
The outlet view of the Gas Valve, shown on the right, shows the Manifold Gas Outlet Connection, the two 24 volt Main Valve (MV) Solenoid connections, and the Manifold Pressure Tap. The two yellow wires from the 12-pin plug on the Ignition Board attach to the MV terminals.



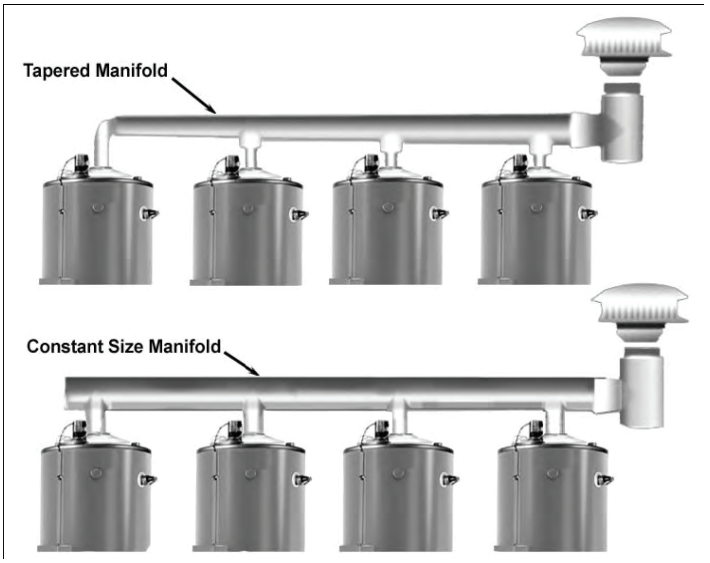
OUTLET VIEW

VENTING

All SBN and SBD water heaters are classified by ANSI as Category I (non-condensing, negative pressure venting) appliances. They are approved for type B vent. The draft inducer does not pressurize the exhaust.



VENTING – MULTIPLE CATEGORY I GAS WATER HEATERS



VENT TABLES FOR CATEGORY I - TYPE B GAS VENT

Multiple Gas Fired Tank-Type Heaters
When venting multiple Category I tank type heaters using Type B vent pipe, follow the installation tables below which give sizing and data based upon NFPA 54/ANSI Z223.1-2006.

Model: **SBN 71-120**										
Input:120,000 Btu/hr.			Total Vent Height (feet)							
Vent Connector Size: 5”			6	8	10	15	20	30	50	100
	Input Btu/hr	Rise	Vent Connector Diameter (inches)							
	120,000	1'	6	6	5	5	5	5	5	5
	120,000	2'	5	5	5	5	5	5	5	5
	120,000	3'	5	5	5	5	5	5	5	5
No. of Units	Combined Input (Btu/hr x 1,000)		Combined Vent/Manifold Diameter							
2	240,000		7	7	6	6	6	6	6	6
3	360,000		8	8	7	7	7	6	6	6
4	480,000		9	9	9	8	8	7	7	6

Model: **SBN 154; SBD30-150**										
Input:150,000/154,000 Btu/hr.			Total Vent Height (feet)							
Vent Connector Size: 6”			6	8	10	15	20	30	50	100
	Input Btu/hr	Rise	Vent Connector Diameter (inches)							
	150,000/154,000	1'	6	6	6	6	6	6	6	6
	150,000/154,000	2'	6	6	6	6	6	6	6	6
	150,000/154,000	3'	6	6	6	6	6	6	6	6
No. of Units	Combined Input (Btu/hr x 1,000)		Combined Vent/Manifold Diameter							
2	300,000/ 308,000		7	7	6	6	6	6	6	6
3	450,000/ 462,000		8	8	7	7	7	6	6	6
4	600,000/ 616,000		9	9	9	8	8	7	7	6

VENT TABLES FOR CATEGORY I - TYPE B GAS VENT

Model: **SBN80-180; SBN100-199; SBN100-200; SBD30-199**										
Input:180,000, 190,000 and 199,000 Btu/hr.			Total Vent Height (feet)							
Vent Connector Size: 6”			6	8	10	15	20	30	50	100
	Input Btu/hr	Rise	Vent Connector Diameter (inches)							
	180,000	1'	7	7	6	6	6	6	6	6
	199,000/200,000	1'	7	7	7	6	6	6	6	6
	180,000	2'	6	6	6	6	6	6	6	6
	199,000/200,000	2'	7	7	6	6	6	6	6	6
	180,000	3'	6	6	6	6	6	6	6	6
	199,000/200,000	3'	6	6	6	6	6	6	6	6
No. of Units	Combined Input (Btu/hr x 1,000)		Combined Vent/Manifold Diameter							
2	360,000		7	7	6	6	6	6	6	6
	398,000/400,000		7	7	7	6	6	6	6	6
3	540,000		7	6	6	6	6	6	6	6
	597,000/600,000		6	6	6	6	6	6	6	6
4	720,000		6	6	6	6	6	6	6	6
	796,000/800,000		6	6	6	6	6	6	6	6

VENT TABLES FOR CATEGORY I - TYPE B GAS VENT

Model: **SBN100-250**										
Input:250,000 Btu/hr.			Total Vent Height (feet)							
Vent Connector Size: 6”			6	8	10	15	20	30	50	100
	Input Btu/hr	Rise	Vent Connector Diameter (inches)							
	250,000	1'	8	8	7	7	7	6	6	6
	250,000	2'	7	7	7	7	6	6	6	6
	250,000	3'	7	7	7	7	6	6	6	6
No. of Units	Combined Input (Btu/hr x 1,000)		Combined Vent/Manifold Diameter							
2	500,000		9	9	9	8	8	7	7	7
3	750,000		12	12	10	10	10	9	8	8
4	1,000,000		14	14	12	12	10	10	9	9

Model: **SBN100-275**										
Input:275,000 Btu/hr.			Total Vent Height (feet)							
Vent Connector Size: 6”			6	8	10	15	20	30	50	100
	Input Btu/hr	Rise	Vent Connector Diameter (inches)							
	275,000	1'	8	8	7	7	6	6	6	6
	275,000	2'	8	8	7	7	6	6	6	6
	275,000	3'	7	7	7	7	6	6	6	6
No. of Units	Combined Input (Btu/hr x 1,000)		Combined Vent/Manifold Diameter							
2	550,000		10	9	9	8	8	8	7	7
3	825,000		12	12	12	10	9	9	8	8
4	1,100,000		14	14	14	12	12	10	9	9

VENT TABLES FOR CATEGORY I - TYPE B GAS VENT

Model: **SBN 85-310**										
Input:310,000 Btu/hr.			Total Vent Height (feet)							
Vent Connector Size: 6”			6	8	10	15	20	30	50	100
	Input Btu/hr	Rise	Vent Connector Diameter (inches)							
	310,000	1'	9	8	8	8	7	7	6	6
	310,000	2'	8	8	8	7	7	7	6	6
	310,000	3'	8	8	8	7	7	7	6	6
No. of Units	Combined Input (Btu/hr x 1,000)		Combined Vent/Manifold Diameter							
2	620,000		10	10	9	9	8	8	7	7
3	930,000		14	12	12	12	10	9	9	8
4	1,240,000		14	14	14	12	12	12	10	9

VENT TABLES FOR CATEGORY I - TYPE B GAS VENT

Model: **SBN 85-366NE, SBN 85-390NE**										
Input:366,000/399,000 Btu/hr.			Total Vent Height (feet)							
Vent Connector Size: 6”			6	8	10	15	20	30	50	100
	Input Btu/hr	Rise	Vent Connector Diameter (inches)							
	366,000	1'	9	9	9	8	8	8	8	8
	399,000	1'	10	9	9	9	8	8	8	8
	366,000	2'	9	9	8	8	8	8	8	8
	399,000	2'	9	9	9	8	8	8	8	8
	366,000	3'	9	8	8	8	8	8	8	8
	399,000	3'	9	9	8	8	8	8	8	8
No. of Units	Combined Input (Btu/hr x 1,000)		Combined Vent/Manifold Diameter							
2	732,000		12	10	10	9	9	9	8	8
	798,000		12	12	10	10	9	9	8	8
3	1,098,000		14	14	14	12	12	10	9	9
	1,197,000		14	14	14	12	12	10	10	9
4	1,464,000		16	16	14	14	14	12	12	10
	1,596,000		16	16	16	14	14	12	12	10

SBN /SBD30-150/199 SEQUENCE OF OPERATION

Sequence

1. Thermistors (probes) call for heat.

2. Inducer fan starts and provides draft.
3. Hot surface igniter = 20 sec. warm-up.

4. Main gas valve opens 4 sec. trial for ignition. (Maximum 5 trials.)

5. Main burner ignites and proves.

6. Thermostat reaches the temperature setting.

7. Main burners “OFF” - Auto restart after 60 min. - 20 sec blower

COMBINED VENTING

COMBINING VENTS (MANIFOLDING

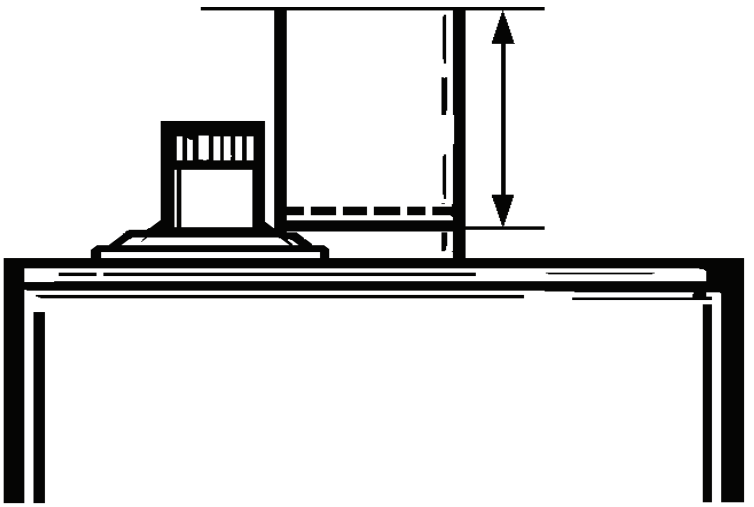
When vents are combined, the area of the combined vent should be equal to area of the largest single vent, plus 50% of area of all others joining.

EXAMPLE: To combine two 6” vents with an 8” vent, the area of a combined vent should be one half area of two 6 inch vents (14 + 14) plus area of 8 inch vent (50) or 78 sq. inches.

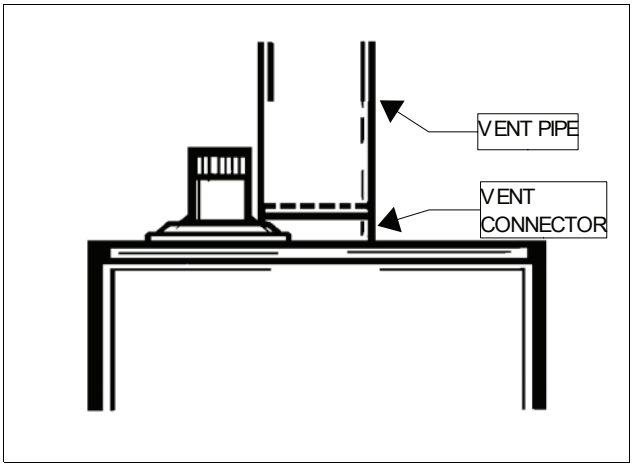
Referring to chart: 78 sq. inches requires a 10” diameter vent.

Vent Size	Area in Square Inches	Vent Size	Area in Square Inches
5"	20	10"	79
6"	28	12"	113
7"	38	14"	154
8"	50	16"	201
9"	64	18"	254

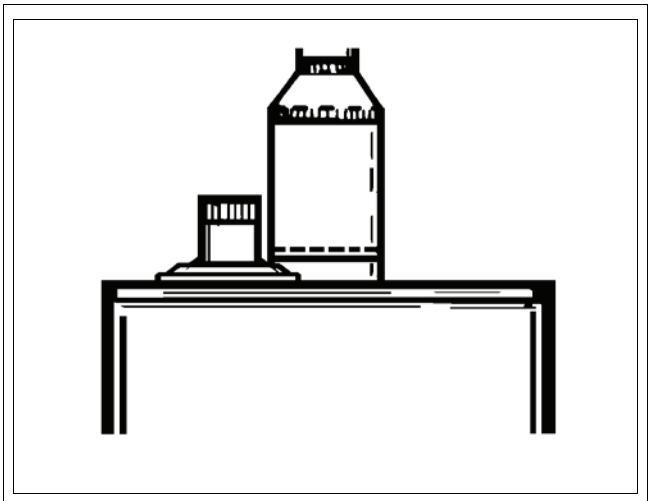
Maximize height from water heater vent connection to first elbow or tee.



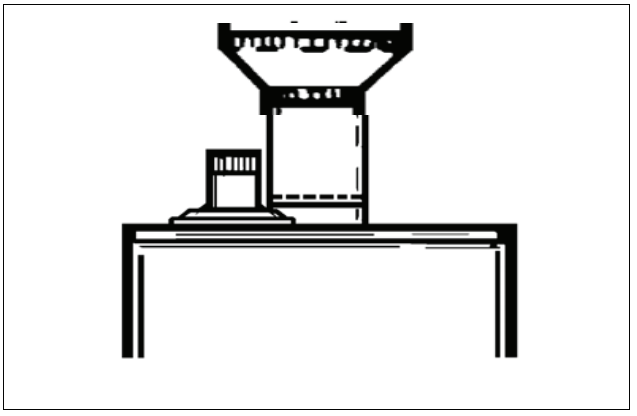
9 RULES FOR GOOD VENTING



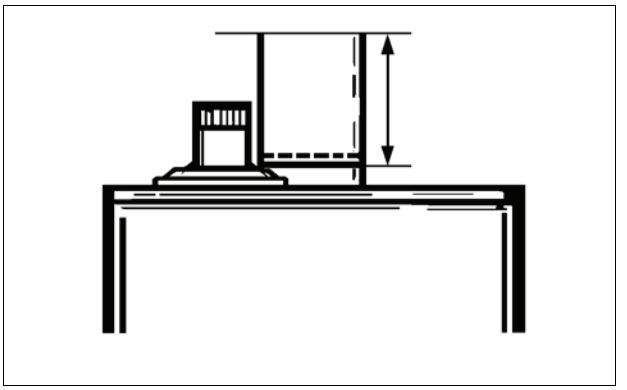
1. The vent pipe should ALWAYS be the same size as the outlet of the draft hood or factory supplied vent reducer.
Model SBN71-120 is supplied with a 6” to 5” reducer.



2. The diameter of a vent pipe should NEVER be reduced, no matter what the circumstances.

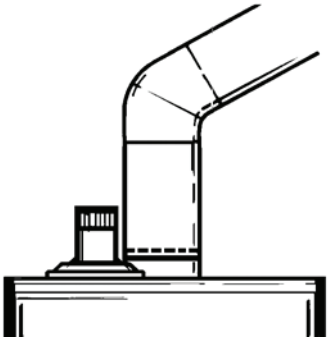


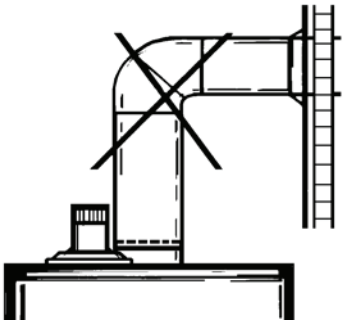
3. In some cases it may be necessary to run a vent larger than the vent connector.



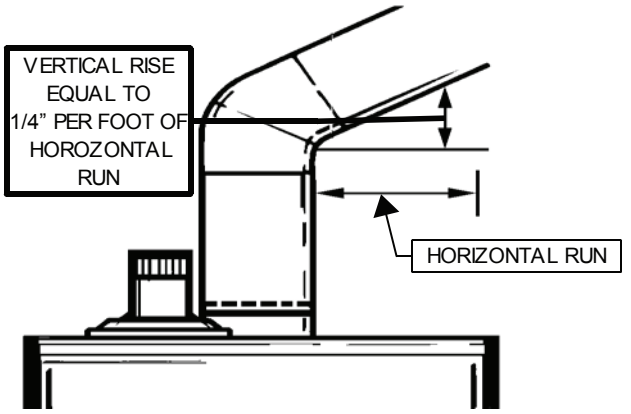
4. Take the maximum vertical rise (x) possible immediately above the draft hood.

9 RULES FOR GOOD VENTING



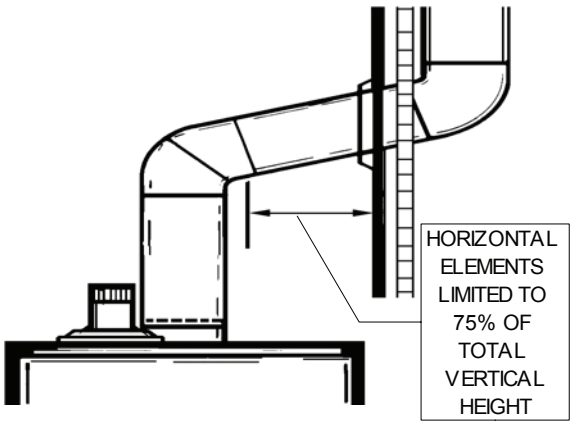


5. Use a 45° elbow in place of a 90° elbow where possible. Avoid the use of a 90° elbow immediately above the draft hood. Allow the maximum vertical rise before any elbow.

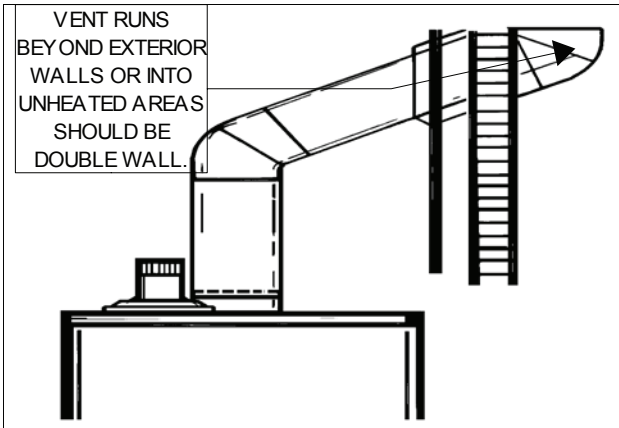


6. Horizontal pipe should be sloped upward at a minimum of ¼" per foot.

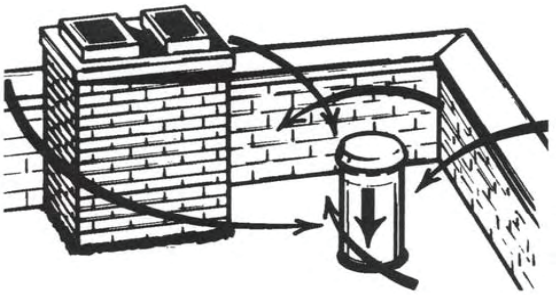
9 RULES FOR GOOD VENTING

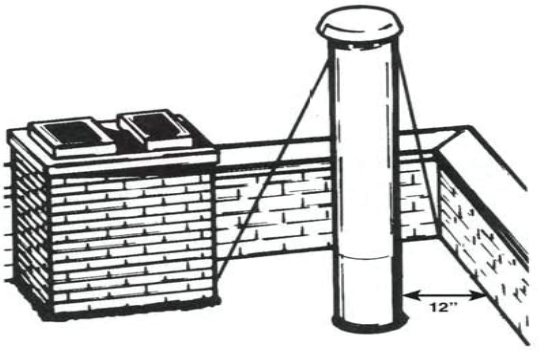


7. Horizontal elements should be limited to 75% of the vertical rise of the vent above the connection.



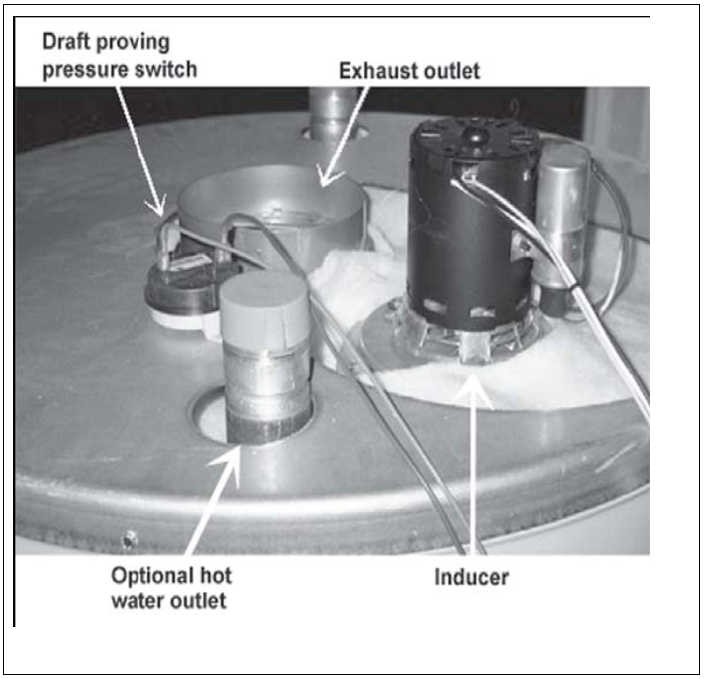
8. Flue gases must be kept hot for proper venting. Single wall vent exposed to cold air may not vent properly.





9. Obstructions can cause down drafts. The vent pipe should be extended to meet local codes.

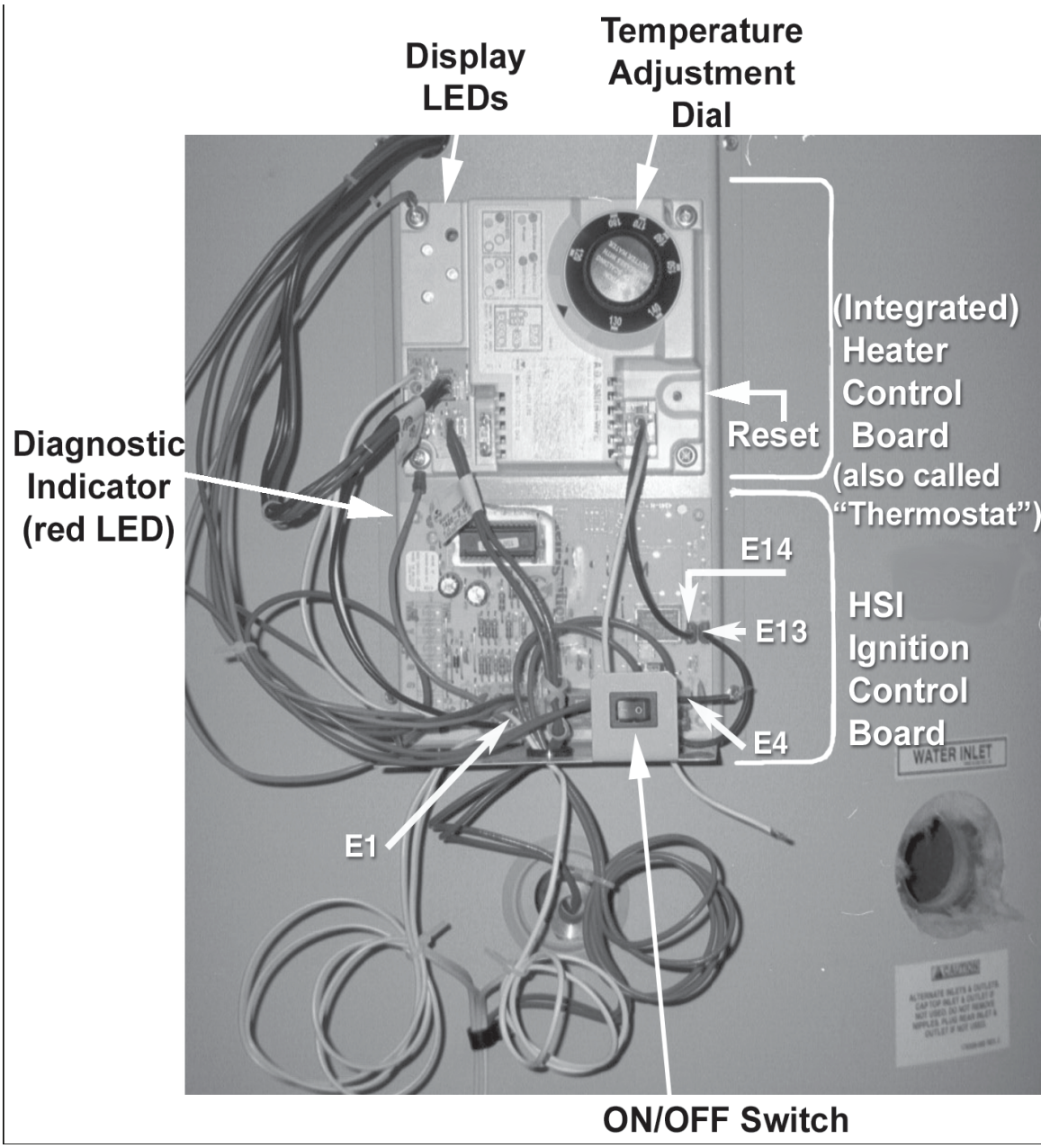
DRAFT PROVING PRESSURE SWITCH - SETTINGS



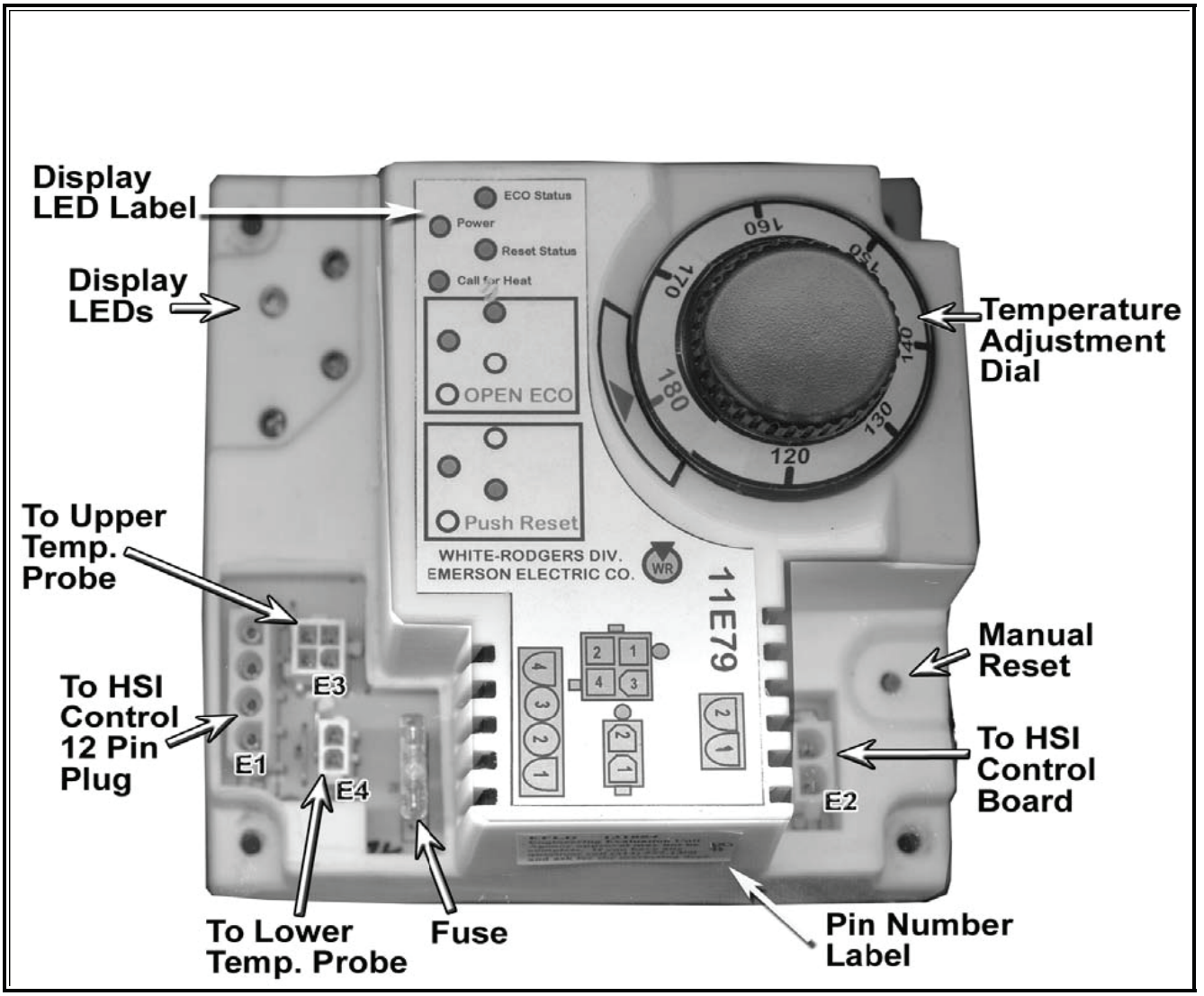
Draft Proving Pressure Switch Table		
SBN Models	**SBD Models**	**Pressure Setting To Close Switch (Inches W.C.)**
366		(-) 1.60 ± .10"
275		(-) 2.00" ± .10"
310		(-) 1,75" ± .10"
120/200		(-) 2.40" ± .10"
154/180		(-) 2.60" ± .10"
	30-150/199	(-) 2.50" ± .10"

NOTE: Pressure Switch Contacts are Normally Open "**N.O.**" and close on a fall in pressure.

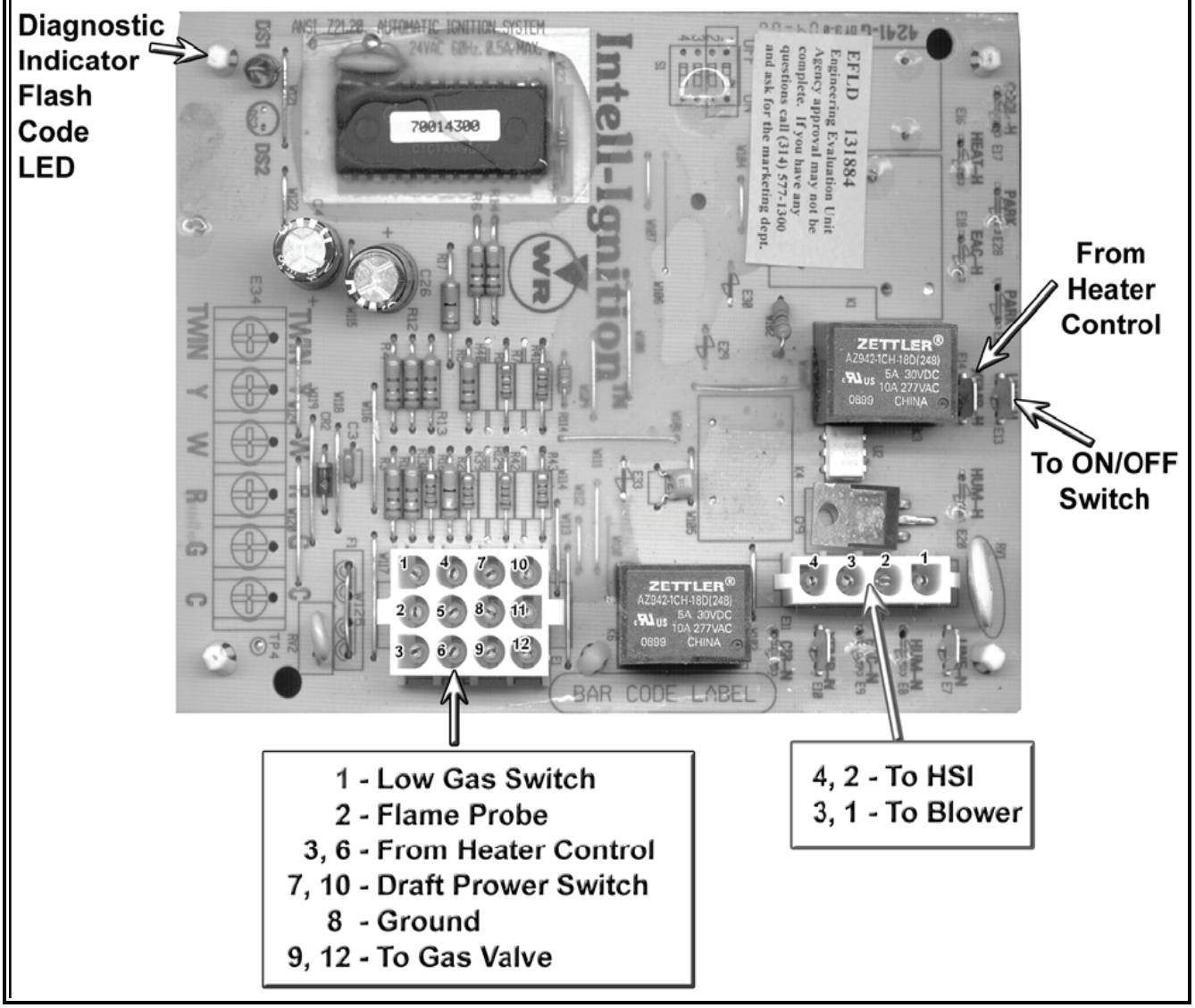
THERMOSTAT AND IGNITION CONTROL BOARD VIEW



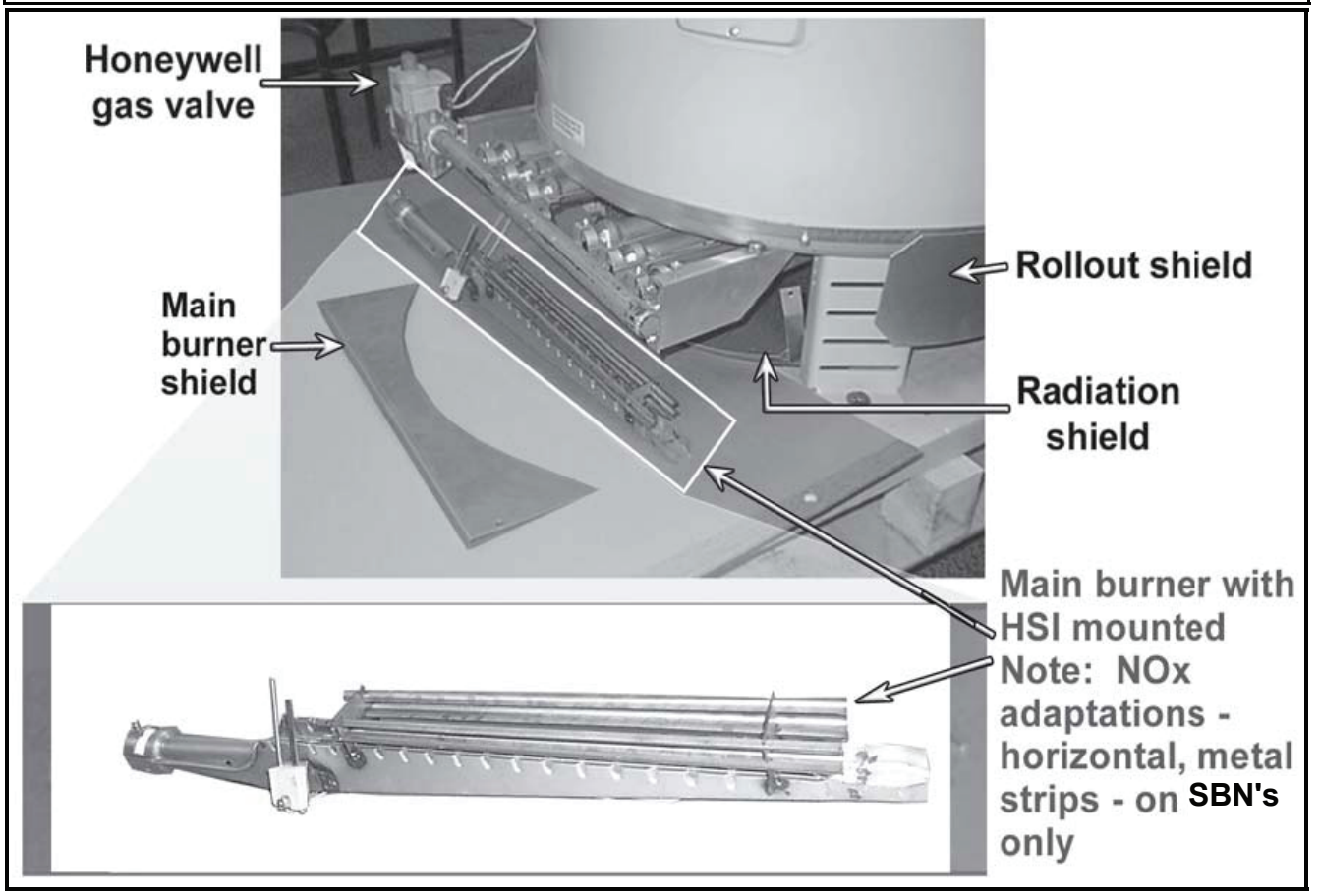
WHITE RODGERS INTEGRATED CONTROL - THERMOSTAT

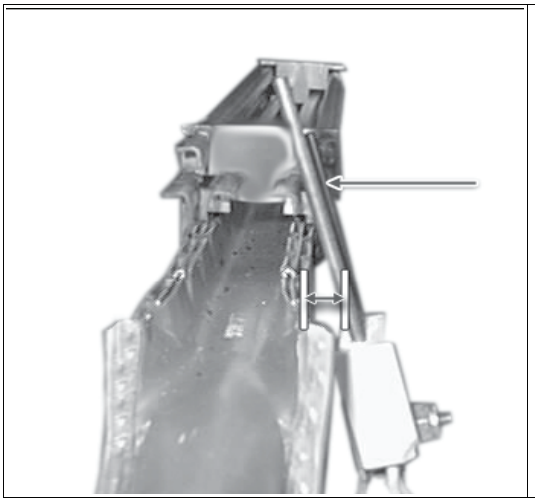


WHITE RODGERS IGNITION CONTROL BOARD



GAS CONTROL VALVE / BURNER AREA VIEW

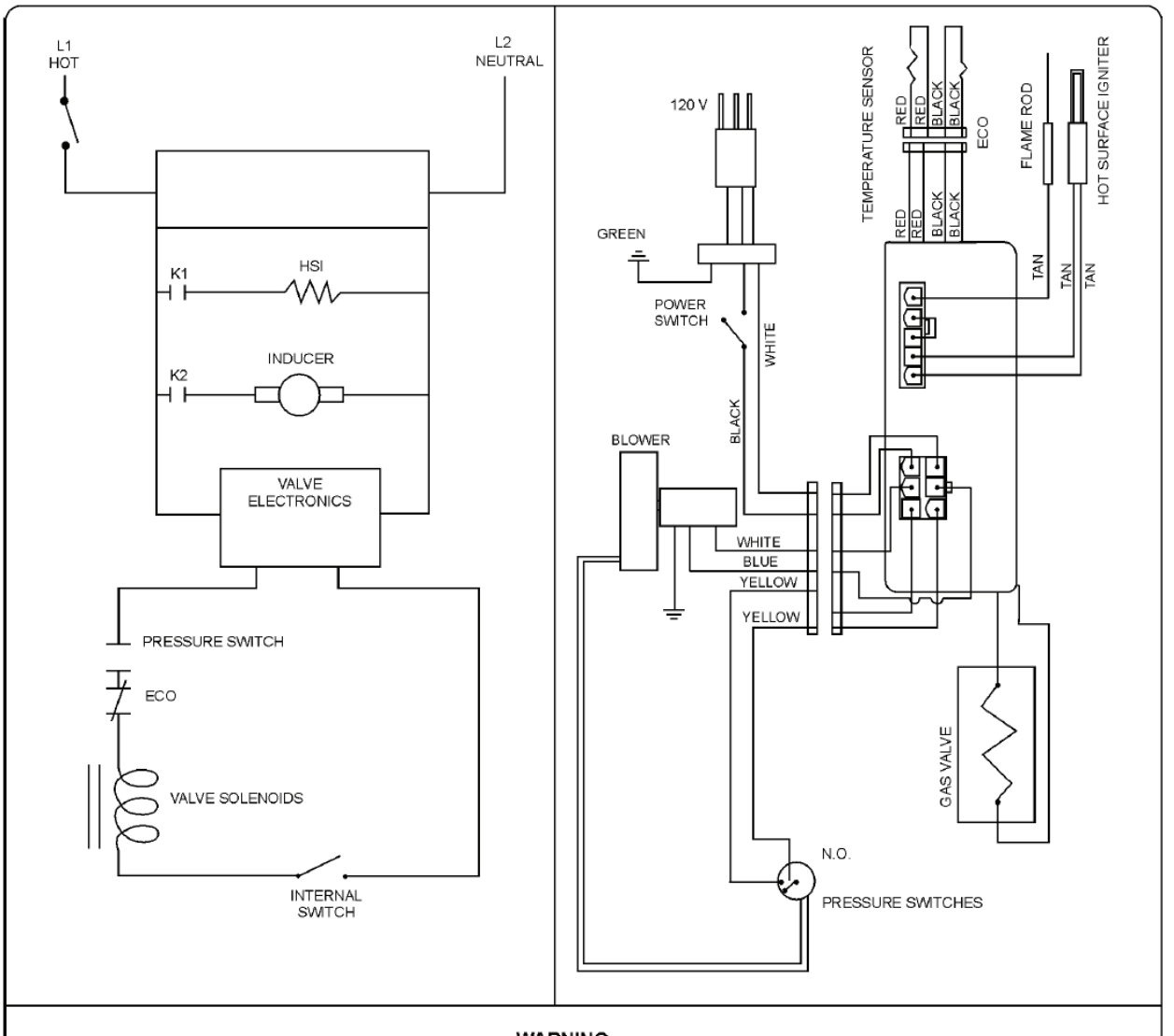




HSI	
Part Number	194405
Volts AC Nominal	80 VAC
Ohms Resistance	11.0 - 20.0 @ 77° F (25° C)

NOTICE FLAME ROD CROSSES PATH OF FLAME **.1 - .25"**

WIRING DIAGRAM



WARNING

DISCONNECT FROM ELECTRICAL SUPPLY BEFORE SERVICING UNIT. REPLACE ALL DOORS AND PANELS BEFORE OPERATING HEATER.

IF ANY OF THE ORIGINAL WIRES SUPPLIED WITH THE APPLIANCE MUST BE REPLACED, IT MUST BE REPLACED WITH APPLIANCE WIRE MATERIAL WITH MINIMUM TEMPERATURE RATING OF 221°F(105°C) AND A MINIMUM SIZE OF NO. 18 AWG.

ELECTRICAL SEQUENCE – SBN, SBD30-150/199

1. Switch Power on to unit.
2. Thermostat calls for heat.
3. Ignition Control Board performs diagnostic check on system components.
4. On completion of diagnostics check, the Ignition Control Board sends signal to Exhaust Inducer.
5. Exhaust Inducer begins drawing air through appliance closing the Prover Switch.
6. On completion of Prover Switch engagement, the Ignition Control Board begins the ignition cycle.
7. The Ignition Control Board provides power to the Silicon Nitride Ignitor.
8. The Silicon Nitride Ignitor heats up for approximately 17 to 20 seconds.
9. At the end of Silicon Nitride Ignitor's warm-up, the Ignition Control Board opens the Gas Valve.
10. From the time the Gas Valve opens, the Ignition Control Board waits 3 seconds and then shuts off power to the Silicon Nitride Ignitor.
11. From the time the Silicon Nitride Ignitor's power is shut off, the Ignition Control Board waits 3 more seconds to monitor the Flame Sensor.
12. If the Flame Sensor does not detect a strong enough flame, the Ignition Control Board shuts off the Gas Valve and allows the Exhaust Inducer to purge the unit for 20 seconds. At that time, the Ignition Control Board restarts with step 7. It will try and ignite the main burners 2 more times. If the unit does not light, the Ignition Control Board will wait one hour and then re-start at step 3. This cycle will continue until the unit lights or the power is shutoff to the unit.
13. If the Flame Sensor detects a strong flame, the Ignition Control Board will allow the unit to operate until the thermostat is satisfied.
14. Once the unit is satisfied, the Ignition Control Board will shut off the Gas Valve and the unit will be in standby mode until another call for heat is initiated by the thermostat.

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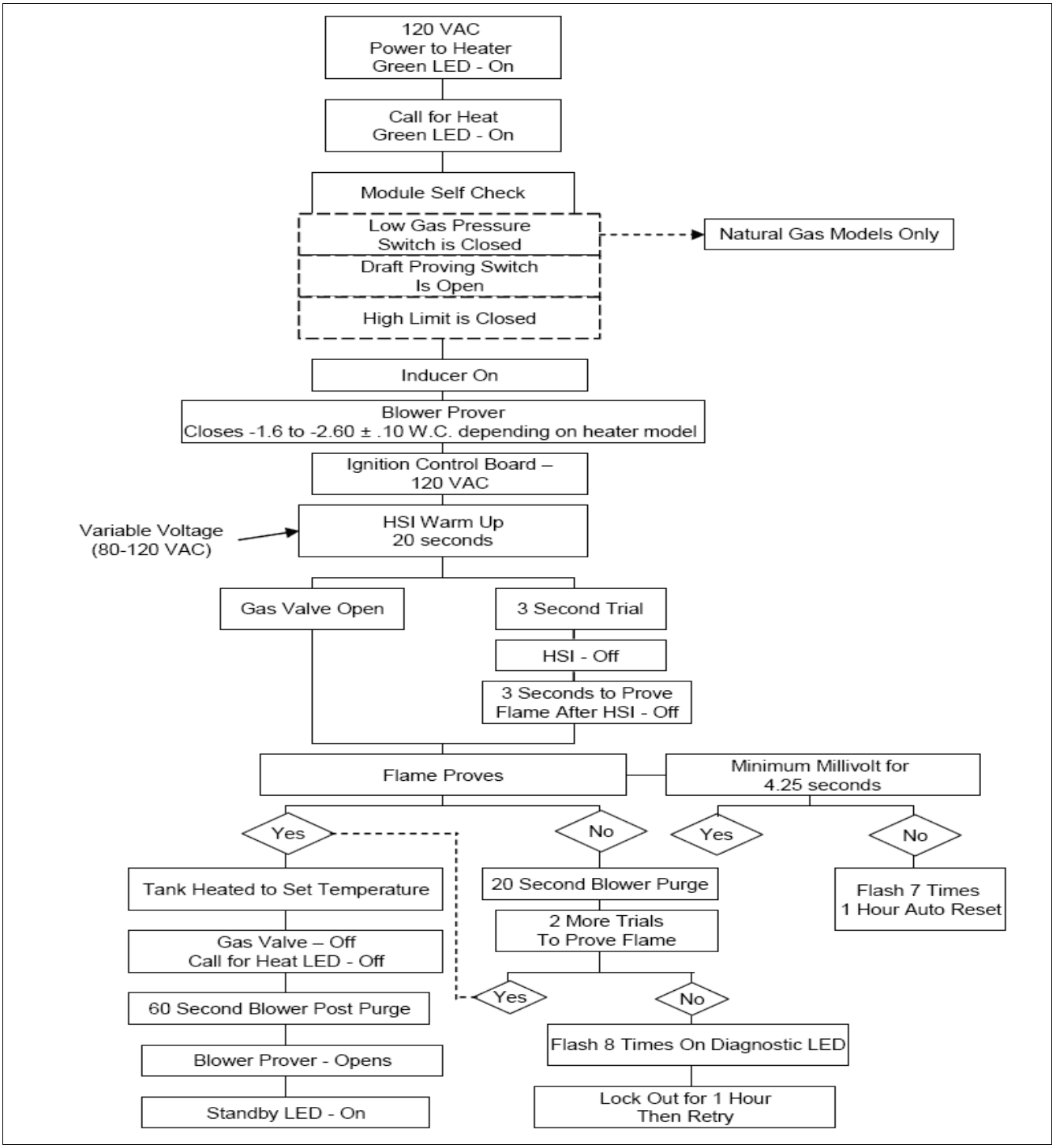
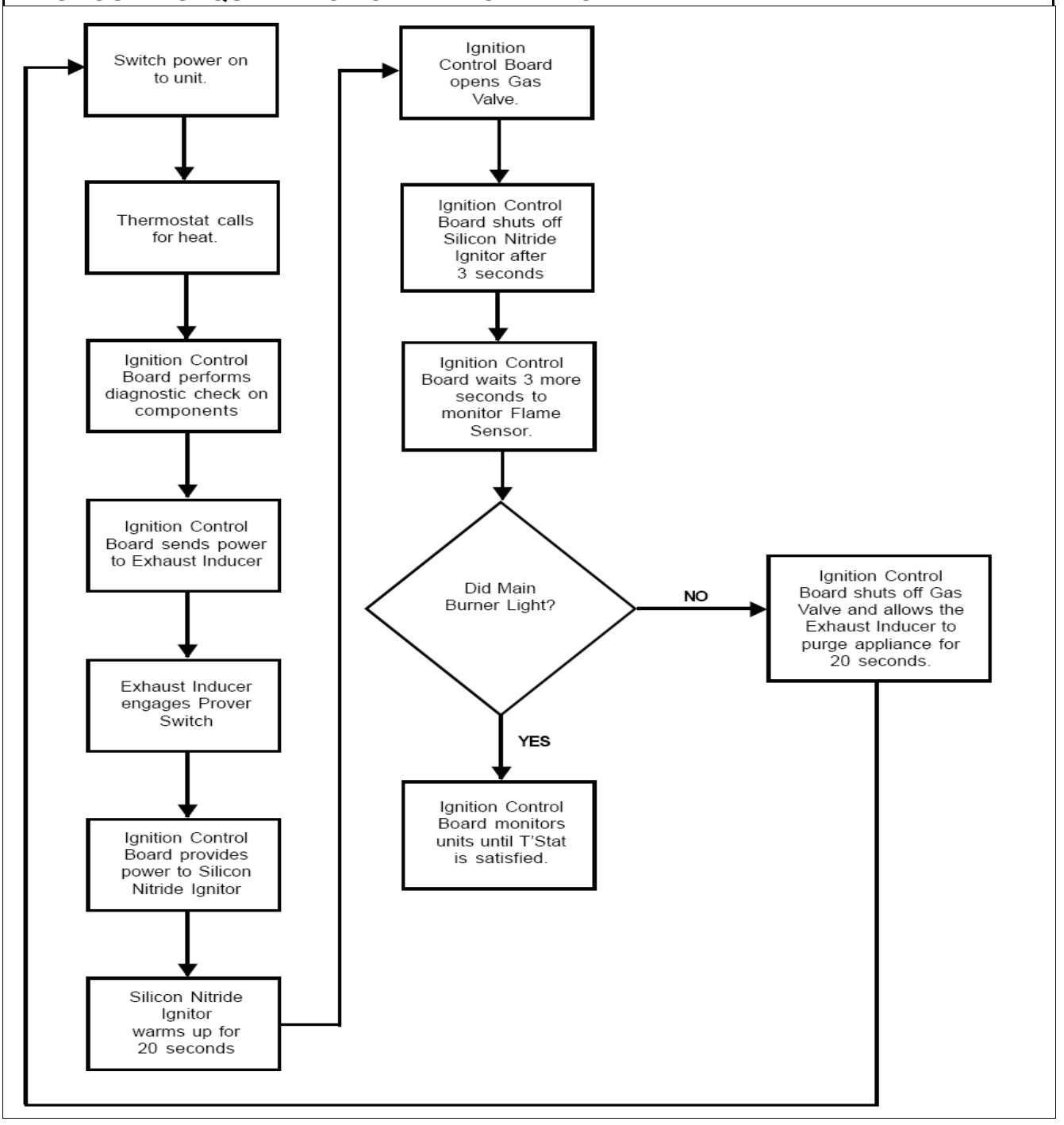
OPERATING SEQUENCE – FLOW CHART



DIAGNOSTIC SEQUENCE OF OPERATION – FLOW CHART



PRE-SERVICE CHECK LIST

Use the following checklist BEFORE you begin servicing the water heater.

1. Have you removed the cover from the controls?

   _____
   Did you take notice of the status lights on the upper water heater control?

   _____
   Did you take notice of the red LED in the upper left corner of the lower ignition control?

   _____

2. Did you note conditions of the room?

   _____
   Where does the supply air come from?

   _____
   Is the room clean?

   _____
   What is stored with the heater?

   _____
   How is the heater vented?

   _____
   Are all water and gas shut-off valves open?

   _____
   Are there room exhaust or air intake fans?

   _____

3. Did you note the condition of the heater?

   _____
   Is the ON/OFF switch “On”?

   _____
   What is the temperature of the stored water? (Test at T&P valve or nearby faucet.)

   _____
   Is the thermal expansion tank installed?

   _____

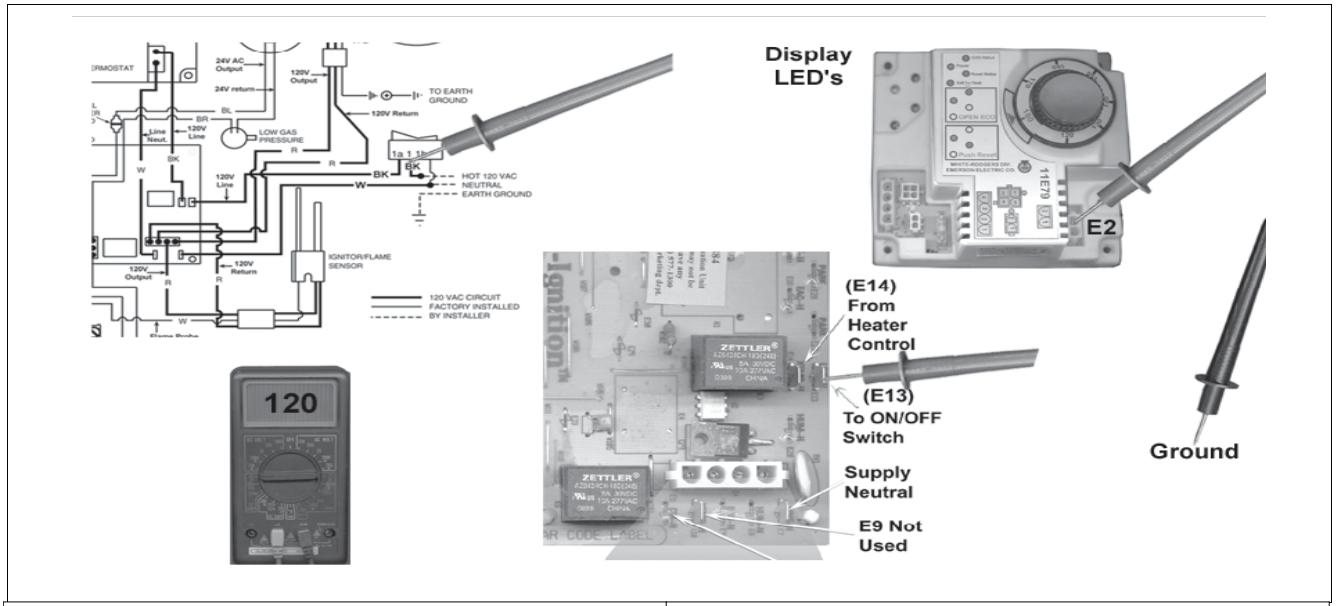
4. Did you write down the complete model and serial number of the water heater? If so, what are they? _____
5. Does the heater have a good ground wire connection? If not, the inducer will typically come on for a short time (3-5 seconds), then go off, and the red LED will flash 8 times.

WATER HEATER CONTROL BOARD TROUBLESHOOTING AND DIAGNOSTIC LED INTERPRETATION

TEST 1 – 120VAC POWER CHECK

- No Green display “Power” LED on.
- Plugs are in receptacles.
- Supply power breaker is not “open”
- On/Off heater switch is “On”.

White Rodgers
Integrated Control



TEST 1	120 V. AC check to water heater ON/OFF switch
	Check for 115-125 V. AC black wire to ground\ 115 V. AC check to E13 Terminal and 2B receptacle.
IF.....	**Then.....**
voltage **is not present** from on/off switch center black wire to ground	Check conditions above Check wiring from switch to break box
Power is **present** from center on/off terminal	Check power from on/off switch to ignition board terminal E13
Voltage **is not present** at E13 to ground	check wiring from on/off. Left-outside terminal to E13. Replace on/off switch.
Power is **present** at E13	Check power from E14 to water heater control E2 receptacle
Voltage is not present from water heater control receptacle E2 black to ground	Check wiring from ignition control board E14 to water heater control receptacle E2. Replace ignition control board.
Power is present at E2.	Green LED should be on.

WATER HEATER CONTROL BOARD TROUBLESHOOTING AND DIAGNOSTIC LED INTERPRETATION

Conditions:

- Power On
- Red, heater control “Call for Heat” LED – on
- Red, ignition control board diagnostic LED – Flashing
- Note LED Flash Code before resetting heater.

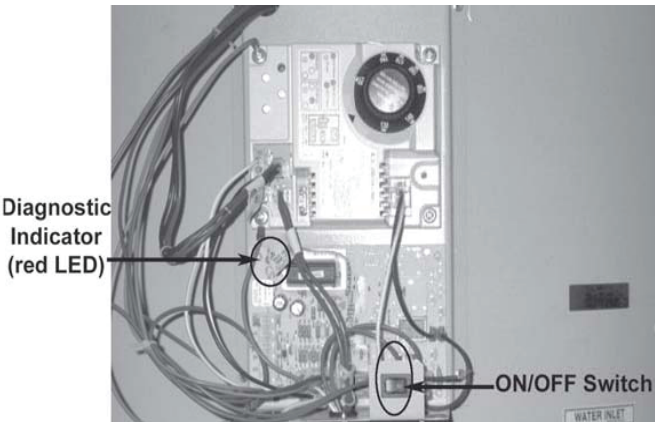
LED Status	Indication
1 Flash	System is in lock out.
2 Flashes	Draft proving (pressure) switch failed to open within 5 seconds at the end of the last cycle.
3 Flashes	Draft proving (pressure) switch failed to close (-2.1 inches of water column pressure) within 5 seconds after the inducer was started. **The low gas pressure switch)closes at 5.2" ± .04" w. c.) may have remained open (Nat Gas only.)**
4 Flashes	Open on high temperature limit switch (ECO).
5 Flashes	Not Used
6 Flashes	115-volt supply power connection is indicating reversed polarity.
7 Flashes	Flame sensor reads a low flame signal for more than 4.25 sec.
8 Flashes	No ignition sensed.
Continuous Flash	Continuous flame sensed for more than 5 seconds without gas valve being energized.
Continuous ON	Internal control board failure.

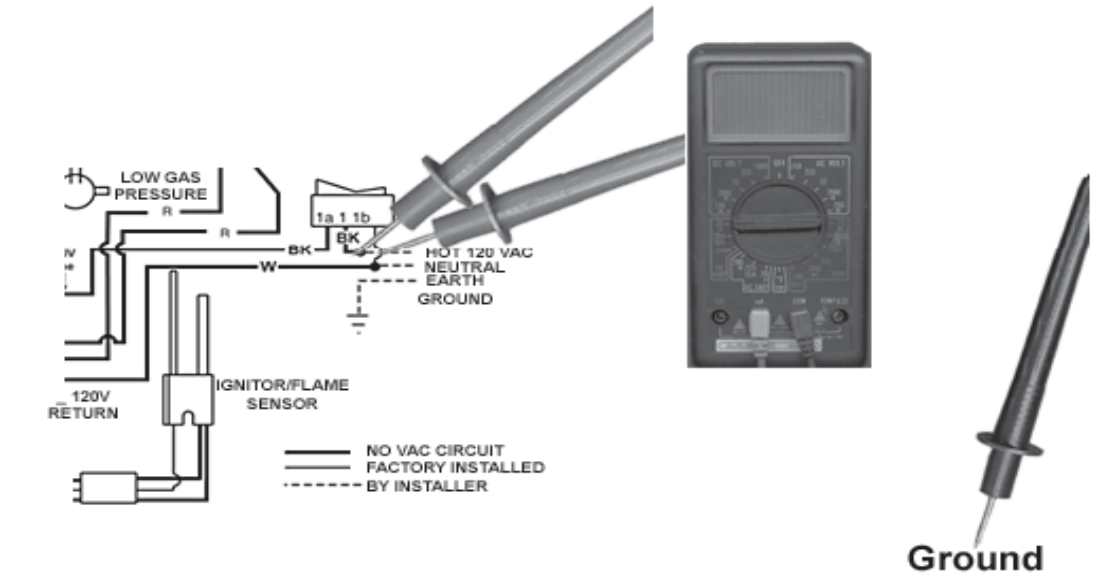
*Control system self adjusts to use a minimum voltage for ignition. Lower voltage results in lower IGNITOR temperature which results in longer IGNITOR life. IGNITOR voltage may vary from Nominal 80 VAC.

TEST 2 – POLARITY CHECK

Conditions:

- No hot water
- Green “Power” LED is on.
- Tank is more than 5° F below temperature dial setting.
- Red ignition control board diagnostic LED is flashing 6 times between pauses.
- Red, diagnostic “Call for Heat” LED-OFF.



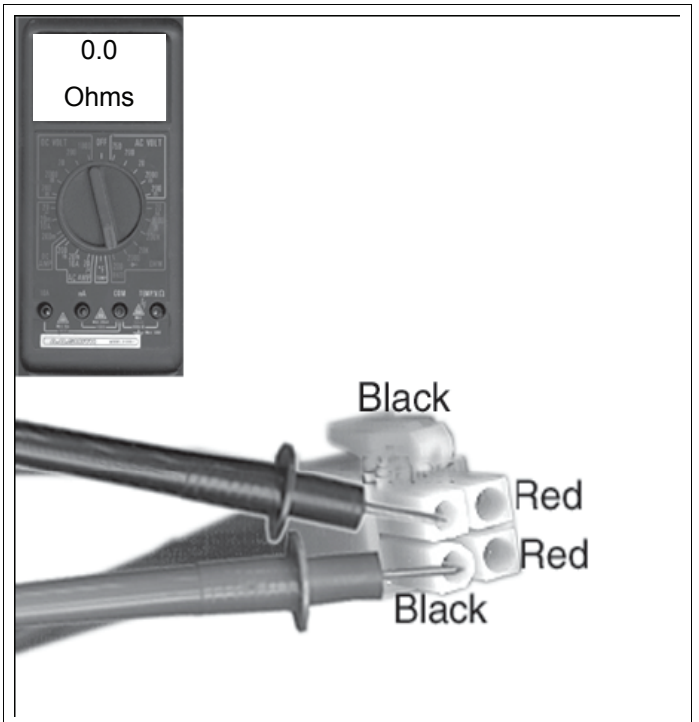


TEST 2	Polarity Check
	Check from on/off switch center and white wire terminals to ground
115-125 VAC is not present	see Test 1.
Voltage **is present** white (right terminal) to ground **but not** black (center terminal) to ground	reverse supply wire connections - polarity is reversed.

TEST 3 - CONTINUITY CHECK OF HIGH LIMIT (ECO)

Conditions:

- Power On – No Hot Water
- Red, heater control "Call for Heat" LED – on
- Red ignition control board diagnostic LED – 4 Flashing
- Note LED Flash Code before resetting water heater control.
- See Description of diagnostic LED Flashes.
- Turn Power "Off"



TEST 3	Continuity check of ECO (energy cut-off, high limit) Black to Black wires of upper probe. Power is off.
If…	**then.....**
continuity **is indicated (ZERO "0.0" Resistance)**	opens at 203° F; closes at 193° F. If water is below 193° F, continuity is correct.
continuity **is not present (meter reads "0.L")**	replace ECO sensor, if water temperature is below 193° F.
water is less than 120° F	•reset status LED should be on. •replace heater control if control will not manually reset.

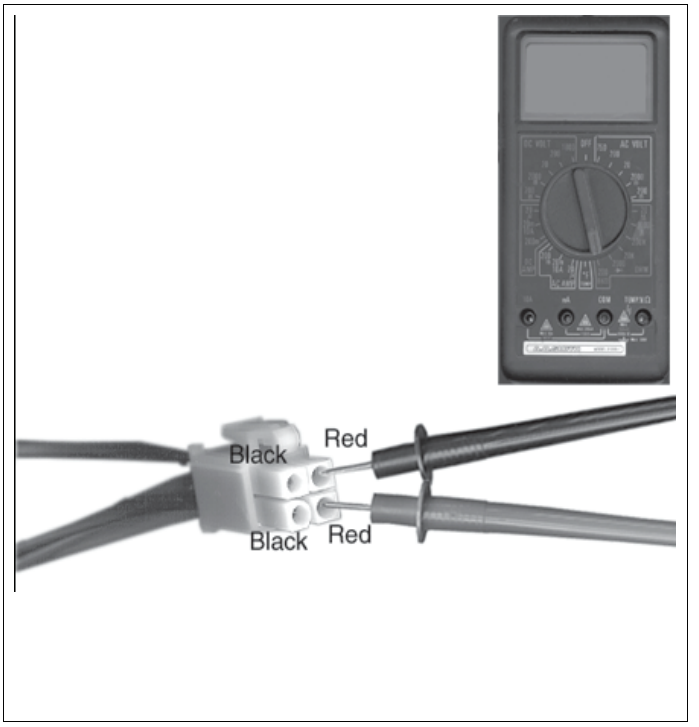
TEST 4 - UPPER TEMPERATURE PROBE CONTINUITY CHECK

Conditions:

- Power On - Water below temperature set point.
- Red, water heater control “Reset Status” LED-OFF
- Call For Heat” LED off.

Ohms Resistance Table

° F	Ohms
70°	11,884
120°	3,759
140°	2,488
180°	1,169



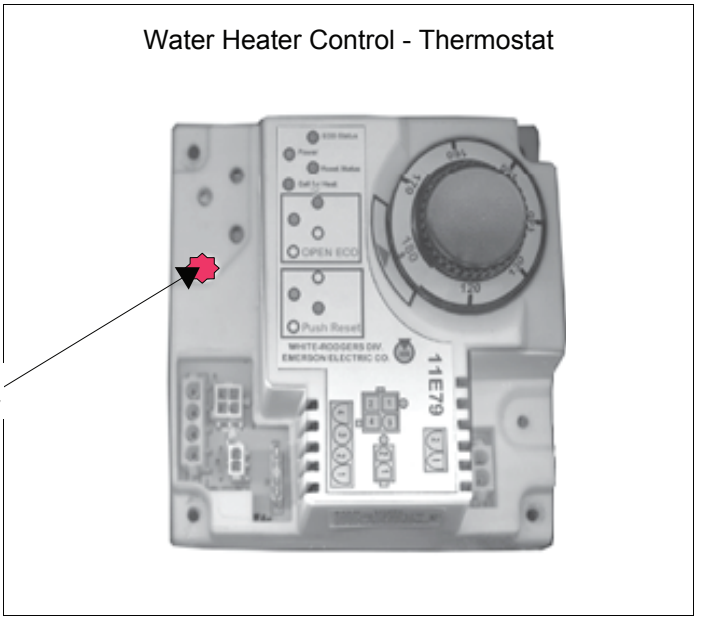
TEST 4	Upper Temperature probe continuity check
	Red wire to red wire - Turn supply power "Off" for this test
If…	**then.....**
Test indicates **no continuity**	Replace probe.
Continuity is indicated	Probe should be okay (also verify Ohms resistance for water temperature). (Reading will be approximate.)

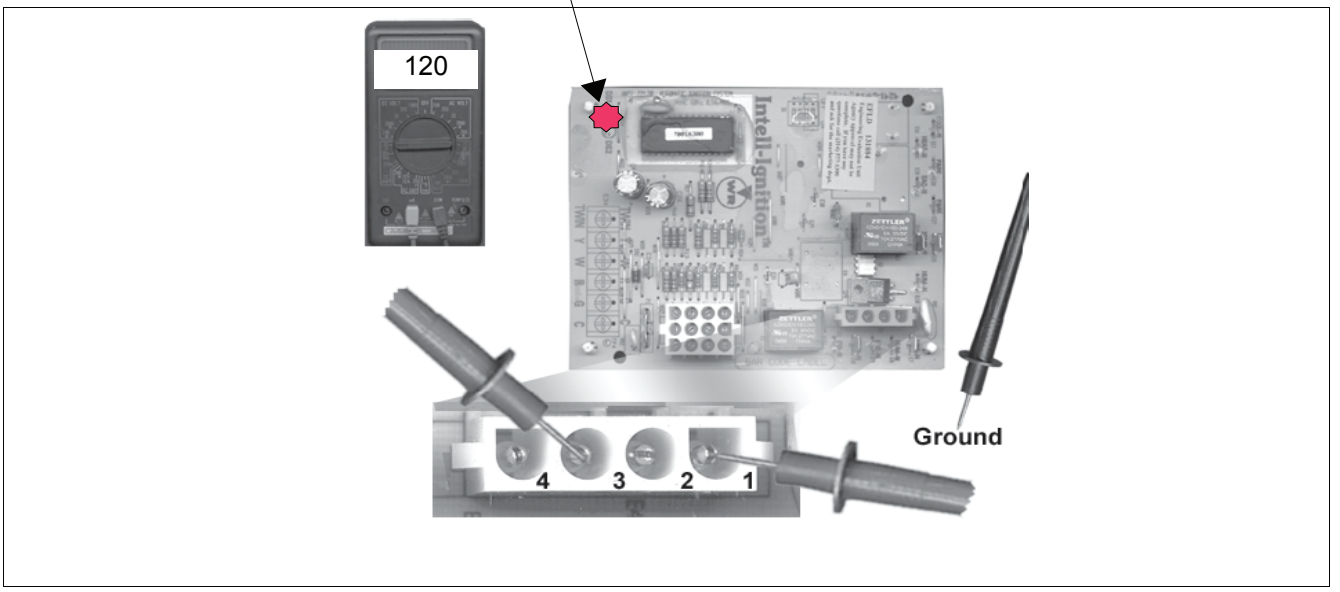
TEST 5 - CALLING FOR HEAT – NO INDUCER OPERATION

Conditions:

- Power on
- Plugs in Receptacles
- Red " Call for Heat" LED-ON
- Inducer "Off"

Note flash code on ignition control board diagnostic LED



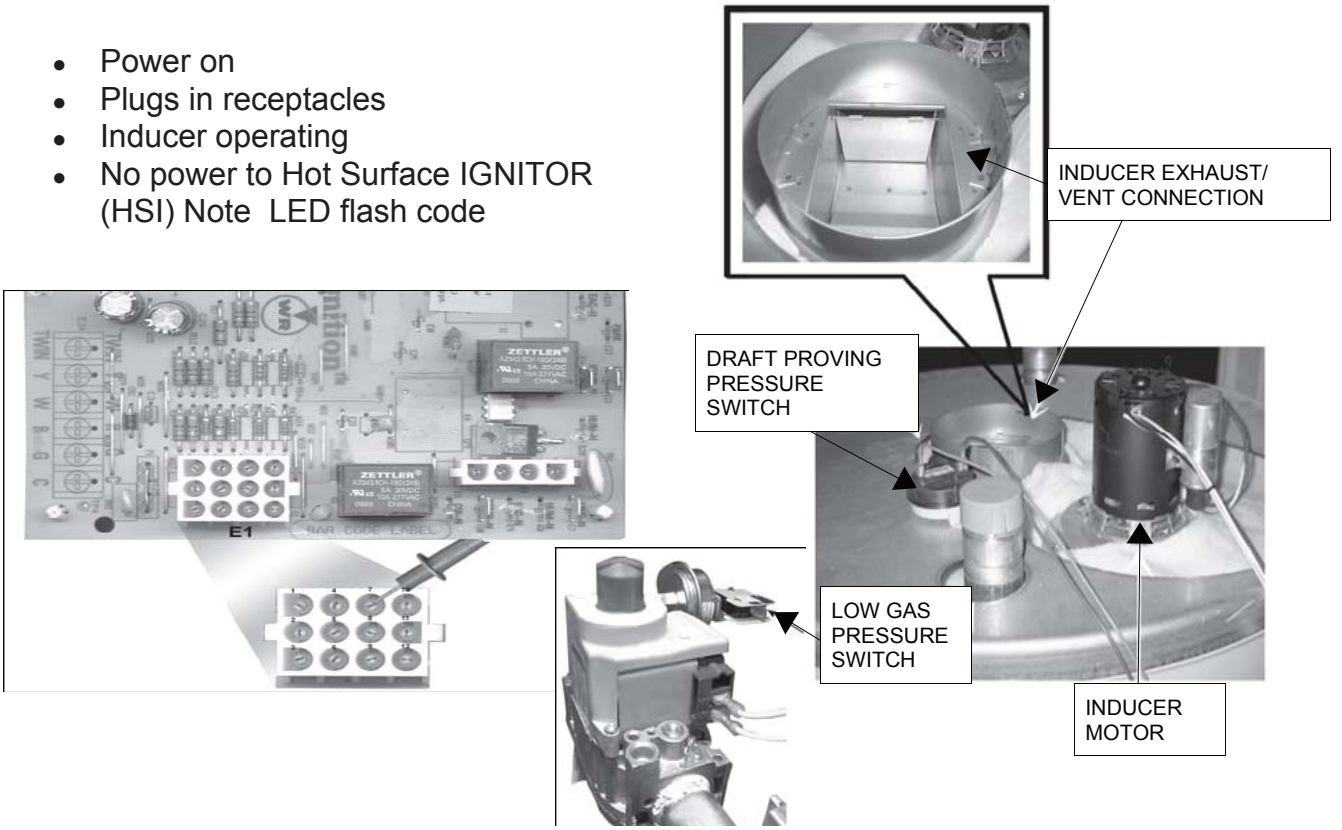


If…	then.....
Pin 1 to ground check **has no voltage**	•reset control by interrupting power - note possible reasons for this from flashing LED code •replace ignition board
Pin 1 to ground **has voltage**	Proceed
Pin 3 to ground **has no voltage**	•check wiring harness and plugs •replace inducer

TEST 6 - INDUCER ON.....NO IGNITION

Conditions:

- Power on
- Plugs in receptacles
- Inducer operating
- No power to Hot Surface IGNITOR (HSI) Note LED flash code

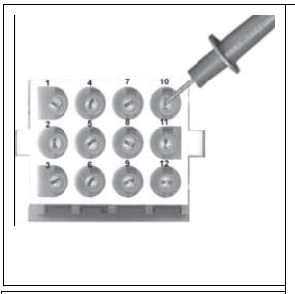


TEST 6	24 VAC Check of Blower Prover/Low Gas Pressure Circuit
If…	**then.....**
ignition board receptacles E1, Pin 7 to ground **shows no voltage**	replace Ignition board
E1, Pin 7 **has 24 Volt** to ground	check wire connection to and from inducer
voltage check of each blower switch terminal to ground **shows voltage** to only 1 terminal	Switch is open - check for proper draft (should also see LED 3 flash code)...Check for blocked exhaust.... Check that blower outlet exhaust damper is open....Replace blower (draft) proving switch
Natural Gas ONLY!	
24V **is present** from each switch terminal to ground	Check wiring from blower switch to low gas pressure switch
Voltage check to each terminal of low gas pressure switch and ground **shows only voltage on 1terminal**	Switch is open - test for a minimum of 5.2 ± " W.C. Natural Gas or 10.5" Propane, flowing supply gas pressure (should also see 3 Flash LED code).....Replace low gas pressure switch
Voltage **is present** to each pressure switch terminal and ground	Check wiring from low gas pressure switch to ignition board receptacles E1, Pin 10

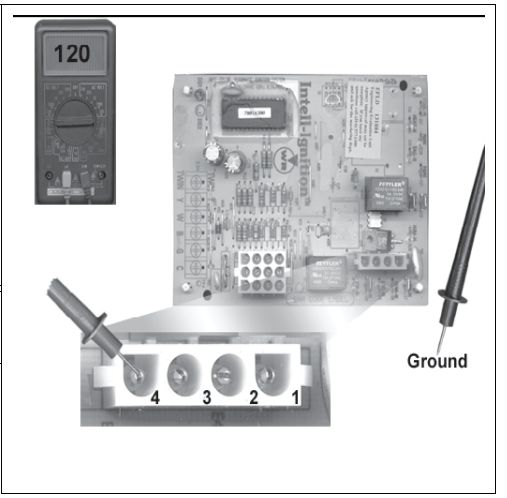
TEST 7 – INDUCER ON, PROVER SWITCH AND LOW GAS PRESSURE SWITCH CLOSED .....NO IGNITOR OPERATION

Conditions:

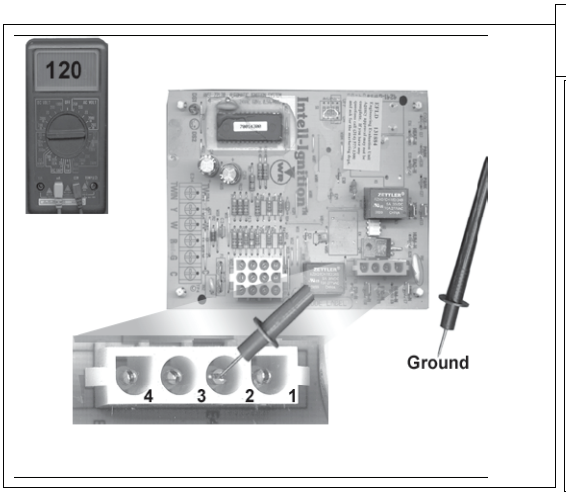
- Power on
- Plugs in receptacles
- Inducer on
- 24V at ignition board E1, Pin 10



CHECK E1PIN 10 TO GROUND – 24 V.



CHECK E4 PIN 4 TO GROUND



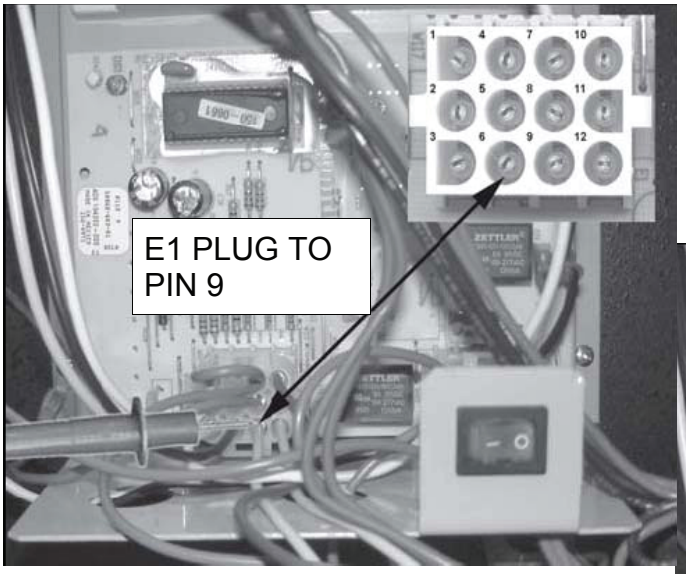
CONTINUITY TEST E4 PLUG

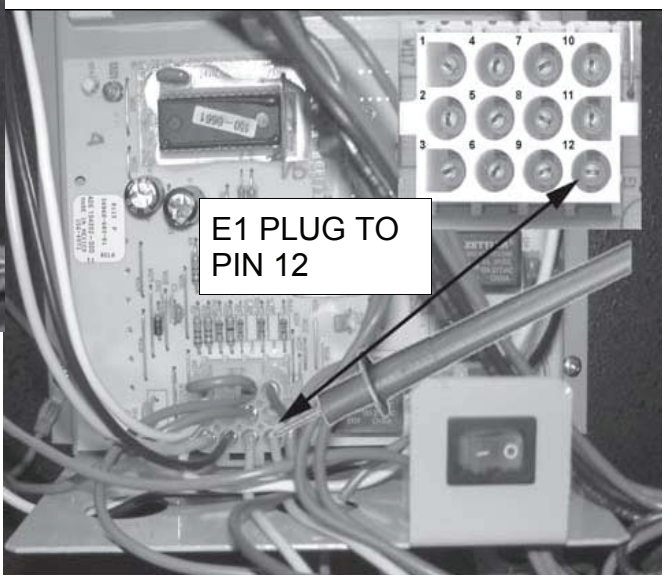
- No Power to IGNITOR Note:LED Flash code

TEST 7	**Voltage check and continuity check of hot surface IGNITOR circuit**
	Continuity check - Power off- Plug removed from E4 receptacles. Nominal 80 VAC check - Plug in E4- Power "On".

If.....	**then.....**
Continuity **is not indicated** between E4plug pin 2 to 4.	Check wiring and connection from E4 plug to HSI receiving plug.....Replace HSI Assembly
Continuity **is present**	Resistance should be between 11 and 20 Ohms at a temperature of 77°F
Voltage **is not present** between E4, Pin 2 to ground	Replace ignition board
Voltage **is present**	**C**ontinue
Voltage **is not present** between E4, Pin 4 to ground	Check wiring and plug connections to HSI.....Replace HSI
Voltage **is present**	Note ignition board, Flash code LED.....HSI should work

TEST 8 – IGNITOR HEATS ..... NO MAIN BURNER



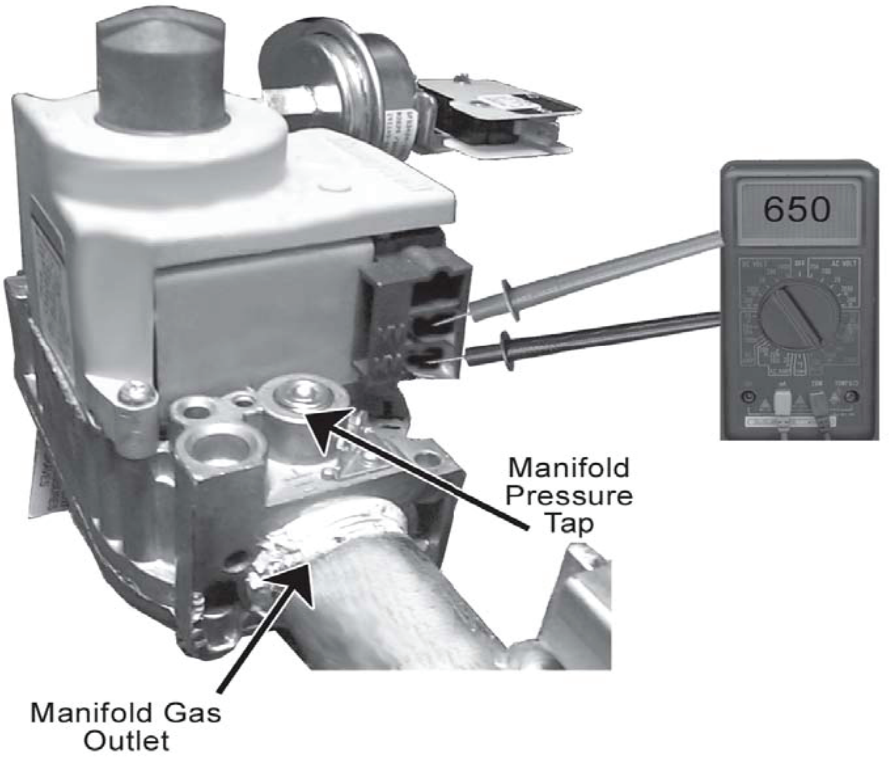


TEST 8	IGNITOR HEATS.....NO MAIN BURNER
If.....	**then.....**
Short heat up time of IGNITOR	Check control box grounding.
Normal (Approximate 20 seconds) warm up - no ignition	Check for 24V from E1, Pin 12 to ground during 4 second trial. .....Yes - Continue.....No - Replace Ignition Board
No voltage present E4, Pin 12 to ground	Replace ignition board
24 Volt **was present** from E1, Pin 12 to ground, but no main burner	Check that air has been purged from gas circuit.....check that wiring and connections to gas valve and E1, Pin 9 are correct .....check for 24 VAC at E1, Pin 9 to ground during 4 second trial for ignition.

TEST 9 – IGNITOR HEATS .....NO MAIN BURNER

Conditions:

- Test 8 completed then:
- Turn off power
- Disconnect wires from gas valve

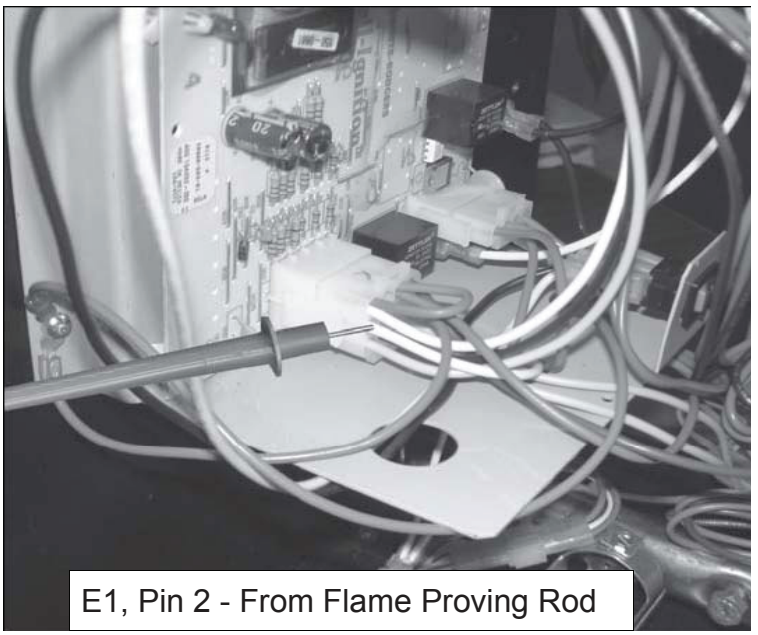


TEST 9	IGNITOR HEATS – NO MAIN BURNER
If…	**then.....**
Meter reads 0 or 1	Check meter scale setting to read between 550 and 650 Ohms Replace Gas Valve
Meter indicates pilot and main coil **have continuity**	Valve should be okay....still no gas to main burner, then coil may be stuck .....Replace Gas Valve

TEST 10 - MAIN BURNER IGNITION FOR LESS THAN 5 SECONDS

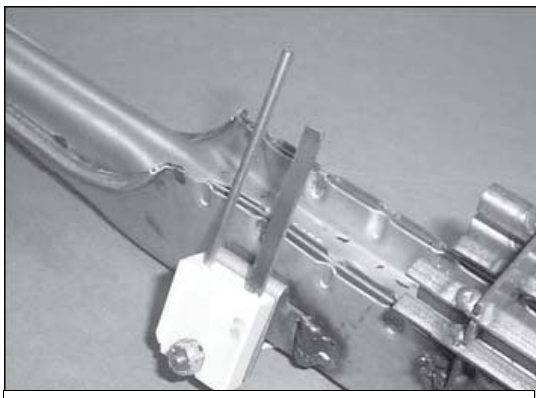
Conditions:

- Power On – plug connected
- Main Burner ignites for approximately 5 seconds then goes out.
- Tests 8 and 9 completed
- Note flash code on ignition board LED.

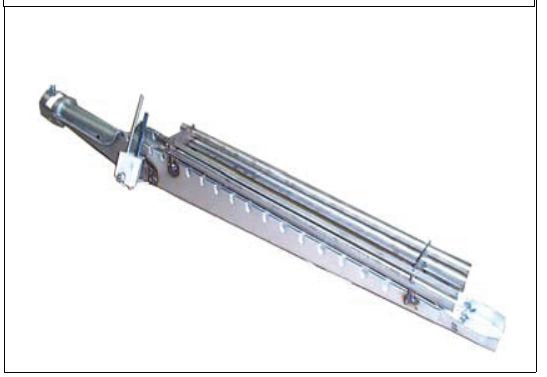


E1, Pin 2 - From Flame Proving Rod

Hot Surface IGNITOR



(Illustration of low NOx burner)

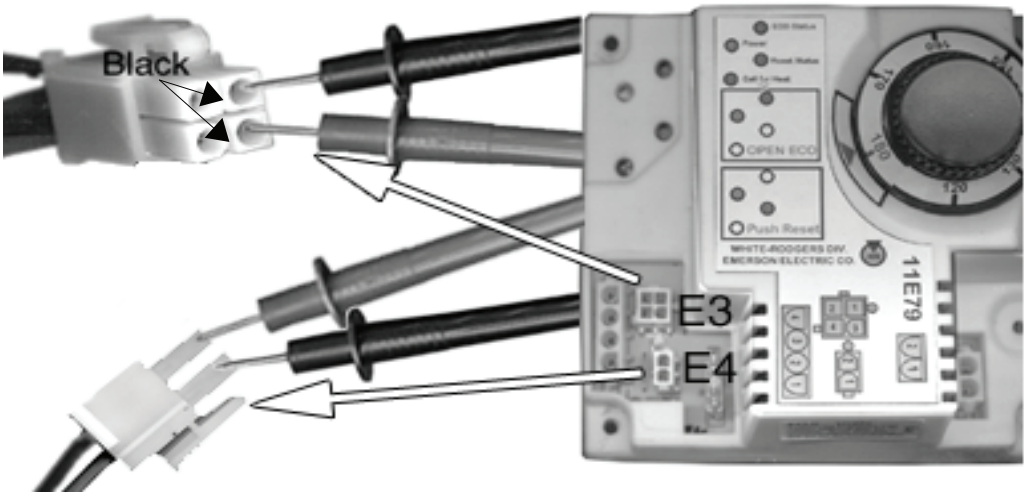


TEST 10	MAIN BURNER IGNITION FOR LESS THAN 5 SECONDS
If.....	**then.....**
No extended main burner ignition	Check wiring and plug connections of HSI assembly plug and ignition board receptacles E1, Pin 2.....Check that HSI assembly is not cracked or dirty.....Check that flame prover will be in main flame .....Replace HSI assembly
Still no extended main burner ignition	Replace ignition control board

TEST 11 - WATER HEATER SHUTTING OFF BELOW SETTING

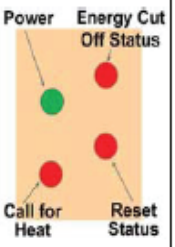
Conditions:

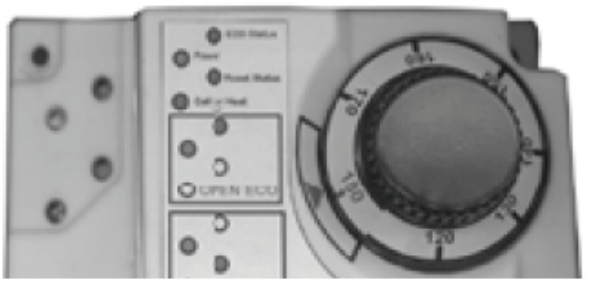
- Main burner ignited
- Stored water is below temperature setting more than 5° F (Tank Average).
- Power off
- Plug disconnected from heater control board receptacle E3 and E4

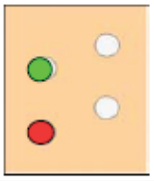
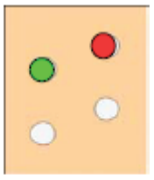
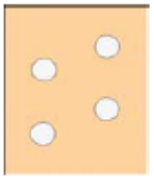
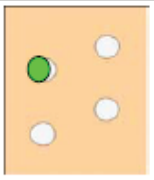
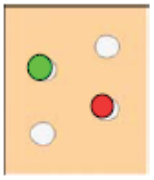


TEST 11	WATER TEMPERATURE CIRCUIT CHECK - CONTINUITY
If…	**then.....**
continuity check pin to pin of lower temperature probe shows 1 or 0 (E4)	See Test 4 Check wiring and plug connections to heater control board receptacle E4 Replace lower temperature probe
continuity check red wire pin to red wire pin on upper temperature sensor shows 1 or 0 (E3)	see Test 4 Check wiring and plug connections to heater control board receptacle Replace upper temperature probe
All above checks are okay	Replace the water heater control.

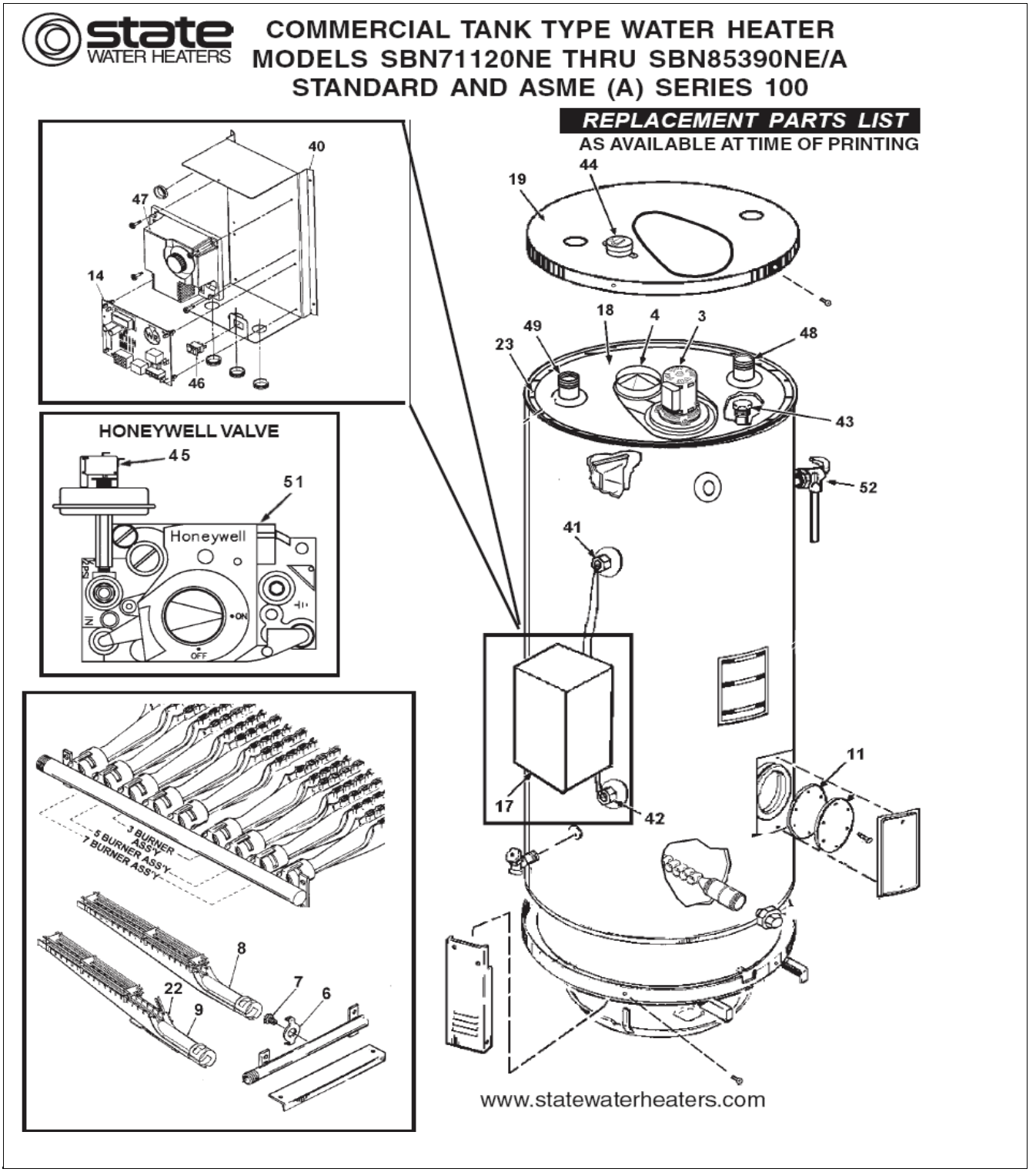
DISPLAY LIGHTS ON INTEGRATED WATER HEATER CONTROL





LED STATUS	INDICATION	ACTION
	Calling for heat	Normal status – none
	The ECO (Energy Cut-Off) has opened.	•Check for excessively hot water .....(203° F or higher). •Correct the problem
	No power	Check the breaker.
	Tank is at a set temperature of .....± 2° F.	No Action Required
	Tank has cooled below 120° F Preceded by “ECO Open” indication	•Push the manual reset button. •Troubleshoot for“why” the ECO opened

PARTS SBN71-120 thru 85-390 series 100



PARTS SBN71-120 thru 85-390 series 100

Item	Description
	Blower Assembly:
3	Blower
4	Outlet Assembly, Exhaust
6	Burner, Orifice Bracket, Main
7	Burner, Orifice, Main (N) SBN
8	Burner Assembly, Main (N) SBN
9	Burner w/Igniter Bracket, Main
11	Gasket, Cleanout
14	Control, Ignition Assembly
17	Cover, Control Box
18	Cover, Inner
19	Cover, Jacket
22	Ignitor, Flame Sensor
23	Insulation, Top
*39	Manual, Instruction-SBN
40	Plate, Mounting
41	Probe/ECO, Upper Thermostat
42	Probe/Lower Thermostat
43	Rod, Anode
44	Switch, Blower Prover
45	Switch, Low Gas Pressure
46	Switch, Off/On
47	Thermostat, Digital
48	Tube, Inlet
49	Tube, Outlet
51	Valve, Gas - Natural SBN
52	Valve, T&P
*53	Wire Harness - Control
*54	Wire Harness - Power

*Items not illustrated. #Quantities shown in parenthesis next to part number. TBD To be determined.
Part numbers underlined are recommended stock items for emergency replacement (consider gas used in your area only).
Request from PSD by giving all information such as model and series number, type of gas and specifications.

PARTS SBN71-120 thru 85-390 series 100

Item	Description
Blower Assembly:	
3	Blower
4	Outlet Assembly, Exhaust
6	Burner, Orifice Bracket, Main
7	Burner Orifice, Main
8	Burner Assembly, Main
9	Burner w/Ignitor Bracket, Main SBN
	Cleanout Assembly:
11	Gasket, Cleanout
14	Control, Ignition Assembly
17	Cover, Control Box
18	Cover, Inner
19	Cover, Jacket
*22	Ignitor, Flame Sensor
23	Insulation, Top
*39	Manual, Instruction
40	Plate, Mounting
41	Probe/ECO, Upper Thermostat
42	Probe/Lower Thermostat
43	Rod, Anode
44	Switch, Blower Prover
45	Switch, Low Gas Pressure
46	Switch, Off/On
47	Thermostat, Digital
48	Tube, Inlet
51	Valve Gas - Natural
52	Valve, T&P
*53	Wire Harness - Control Natural
*54	Wire Harness - Power

*Items not illustrated. #Quantities shown in parenthesis next to part number. TBD To be determined.
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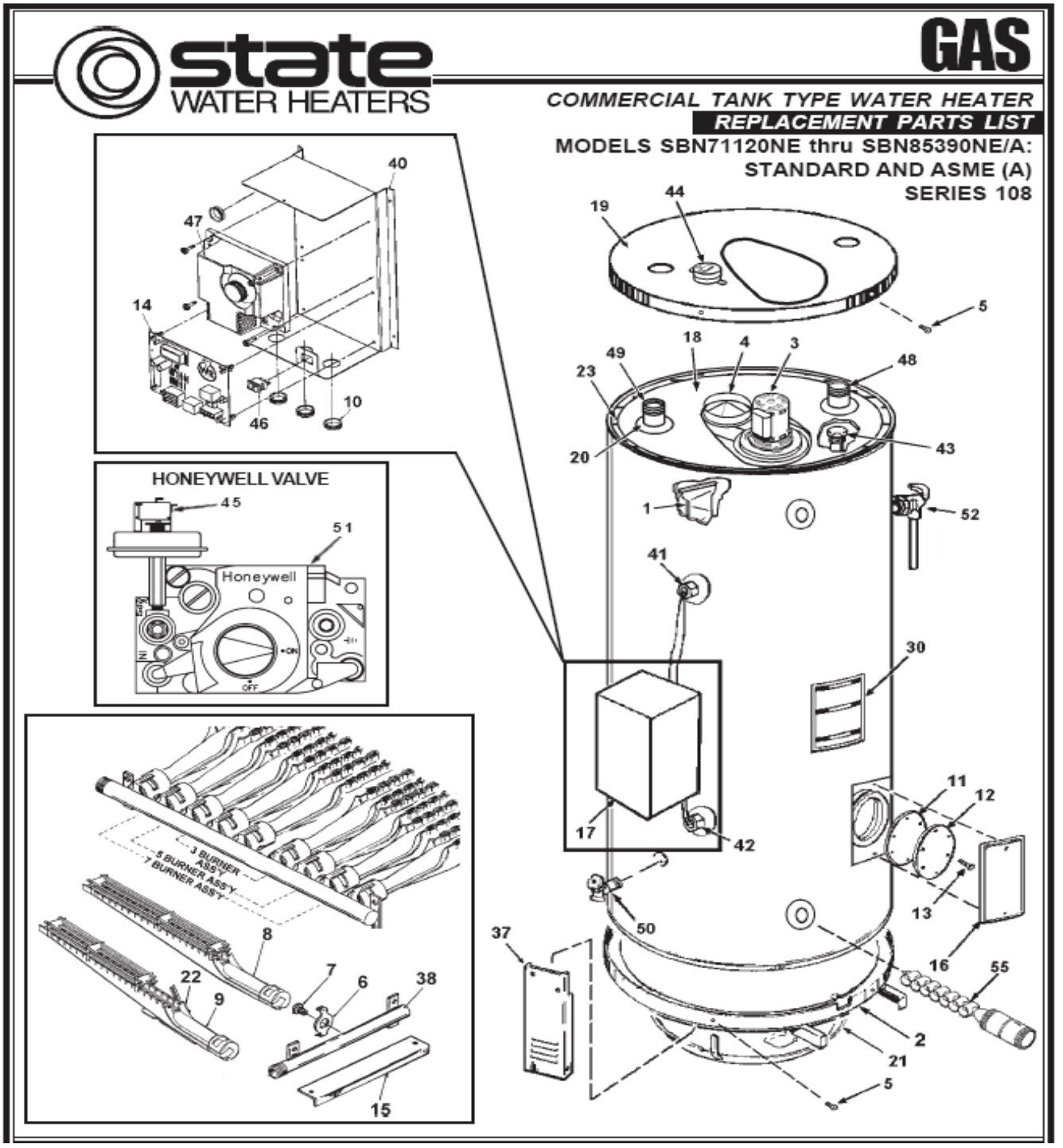
High Altitude Main Burner Orifice Table (NEO)	
Model	**Orifice Drill Size**
120	37
154	42
180	37
250	32
275	38
310	36
366	32
390	31

PARTS SBN71-120 thru 85-390 series 108



PARTS SBN71-120 thru 85-390 series 108

Item	Description
1	Baffle, Flue
2	Base, Jacket Assembly
	Blower Assembly
3	Blower
4	Outlet Assembly, Exhaust
*5	Screw, TEK (Jacket-Cover/Base)
6	Burner, Orifice Bracket, Main
7	Burner Orifice, Main
8	Burner Assembly, Main
9	Burner w/Ignitor Bracket, Main
10	Bushing
	Cleanout Assembly
11	Gasket
12	Pressure Plate
#13	Screws, Machine
14	Control, Ignition Board
15	Cover, Burner
16	Cover, Cleanout
17	Cover, Control Box
18	Cover, Inner
19	Cover, Jacket
20	Collar, Pipe Nipple
21	Floor Shield Assembly
22	Ignitor, Flame Sensor
23	Insulation, Top
	Labels
*24	Cleanout
*25	Flammable Vapors
*26	Help Line
*27	Instruction
*28	Instruction, Bilingual
*29	Instruction, ECO
30	L&O Label
*31	Sandblaster
*32	Relief Valve
*33	Ultra Coat
*34	Water Inlet
*35	Water Outlet
*36	Wiring Diagram
37	Leg
38	Manifold
*39	Manual, Instruction
40	Plate, Mounting
41	Probe/ECO, Upper Thermostat
42	Probe/Lower Thermostat
43	Rod, Anode
44	Switch, Blower/Prover
45	Switch, Low Gas Pressure
46	Switch, Off/On
47	Thermostat, Digital
48	Tube, Inlet
49	Tube, Outlet
50	Valve, Drain
51	Valve, Gas - Natural
52	Valve, T&P
*53	Wire Harness - Control
*54	Wire Harness - Power
55	Hydro Cannon

PARTS SBN71-120 thru 85-390 series 108

Item	Description
1	Baffle, Flue
2	Base, Jacket Assembly
	Blower Assembly:
3	Blower
4	Outlet Assembly, Exhaust
*5	Screw, TEK (Jacket-Cover/Base)
6	Burner, Orifice Bracket, Main
7	Burner Orifice, Main
8	Burner Assembly, Main
9	Burner w/Ignitor Bracket, Main
10	Bushing
	Cleanout Assembly:
11	Gasket
12	Pressure Plate
#13	Screws, Machine
14	Control, Ignition Assembly
15	Cover, Burner
16	Cover, Cleanout
17	Cover, Control Box
18	Cover, Inner
19	Cover, Jacket
20	Collar, Pipe Nipple
21	Floor Shield Assembly
22	Ignitor, Flame Sensor
23	Insulation, Top
	Labels:
*24	Cleanout
*25	Flammable Vapors
*26	Help Line
*27	Instruction
*28	Instruction, Bilingual
*29	Instruction, ECO
30	L&O Label
*31	Sandblaster
*32	Relief Valve
*33	Ultra Coat
*34	Water Inlet
*35	Water Outlet
*36	Wiring Diagram
37	Leg
38	Manifold
*39	Manual, Instruction
40	Plate, Mounting
41	Probe/ECO, Upper Thermostat
42	Probe/Lower Thermostat
43	Rod, Anode
44	Switch, Blower Prover
45	Switch, Low Gas Pressure
46	Switch, Off/On
47	Thermostat, Digital
48	Tube, Inlet
49	Tube, Outlet
50	Valve, Drain
51	Valve, Gas - Natural
52	Valve, T&P
*53	Wire Harness - Control
*54	Wire Harness - Power
55	Hydro Cannon

*Items not illustrated. # Quantities shown in parenthesis next to part number. TBD To be determined.
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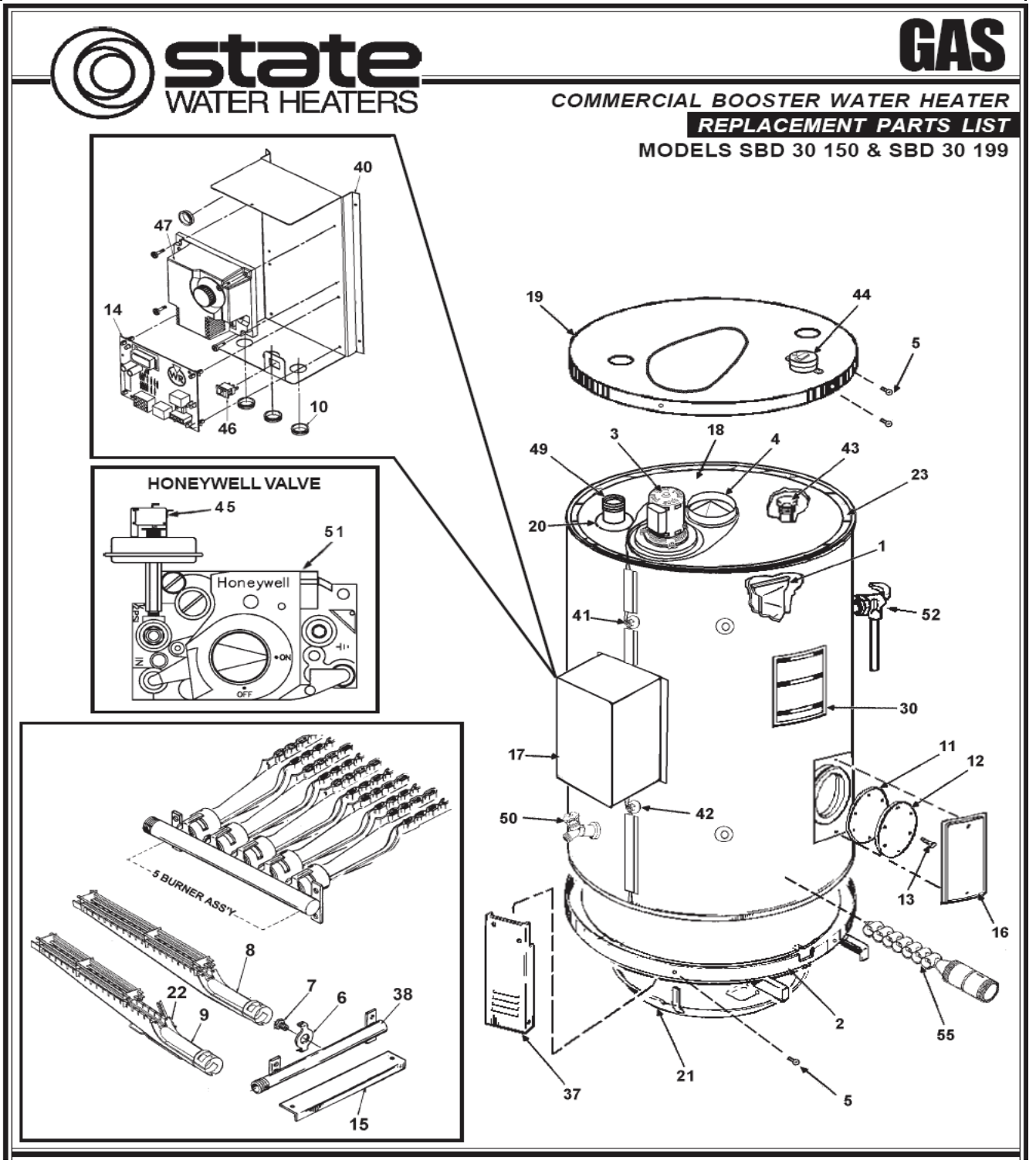
PARTS SBD30-150/199NE



PARTS SBD30-150/199NE

Item	Description
1	Baffle, Flue
2	Base, Jacket Assembly
	Blower Assembly:
3	Blower
4	Outlet Assembly, Exhaust
*5	Screw, TEK (Jacket-Cover/Base)
6	Burner, Orifice Bracket, Main
7	Burner Orifice, Main - Natural
7	Burner Orifice, Main - LP
8	Burner Assembly, Main
9	Burner w/Ignitor Bracket, Main
10	Bushing
	Cleanout Assembly:
11	Gasket
12	Pressure Plate
#13	Screws, Machine
14	Control, Ignition Assembly
15	Cover, Burner
16	Cover, Cleanout
17	Cover, Control Box
18	Cover, Inner
19	Cover, Jacket
20	Collar, Pipe Nipple
21	Floor Shield Assembly
22	Ignitor, Flame Sensor
23	Insulation, Top
	Labels:
*24	Cleanout
*25	Flammable Vapors
*26	Help Line
*27	Instruction
*28	Instruction, Bilingual
*29	Instruction, ECO
30	L&O Label
*31	Sandblaster
*32	Relief Valve
*33	Ultra Coat
*34	Water Inlet
*35	Water Outlet
*36	Wiring Diagram
37	Leg
38	Manifold
*39	Manual, Instruction
40	Plate, Mounting
41	Probe/ECO, Upper Thermostat
42	Probe/Lower Thermostat
43	Rod, Anode
44	Switch, Blower Prover
45	Switch, Low Gas Pressure - Natural
45	Switch, Low Gas Pressure - LP
46	Switch, Off/On
47	Thermostat, Digital
49	Tube, Outlet
50	Valve, Drain
51	Valve, Gas - Natural
51	Valve, Gas - LP
52	Valve, T&P
*53	Wire Harness - Control
*54	Wire Harness - Power
55	Hydro-Cannon

*Items not illustrated. # Quantities shown in parenthesis next to part number. TBD To be determined.
Part numbers underlined are recommended stock items for emergency replacement. (Consider gas used in your area only).
Requests from PSD by giving all information such as model and series number, type of gas and specifications

Prepared by the State Water Heaters Training Department.
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